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MULTISERVICE TACTICS, TECHNIQUES, AND PROCEDURES FOR NBC/TIM CONTANIMATION AVOIDANCE
(FIRST DRAFT)

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HEADQUARTERS DEPARTMENT OF THE ARMY

Preface

This publication is designed for use at the tactical and operational level. It defines the roles and functions of commanders and NBC staff planners in contamination avoidance activities. It provides multiservice Tactics, Techniques, and Procedures (TTP) for contamination avoidance to be used by the Army, Air Force, Marine, and ashore Naval forces. Afloat Naval forces may have to use nuclear and radiological contamination avoidance TTP due to differing detection devices and units of measure. This doctrine for contamination avoidance takes into account each type of potential military contamination – nuclear, biological, and chemical as well as potential toxic industrial materials (TIM) that may be encountered.

This MTTP blends key points of Joint Pub 3-11, **Joint Doctrine for Operations in NBC Environments**, into its approach to ensure inclusion of multiservice elements of a joint force. This manual addresses the roles and functions within a multiservice operation and the key functional planning considerations of the Service and joint commander at the operational and tactical levels of war.

This manual discusses detection and identification concepts and systems, reconnaissance and surveillance planning, and the current warning and reporting system. It also presents a thorough discussion of the concept of interactive NBC networking which provides a methodology for the management and analysis of battlefield sensor information. By understanding these systems and concepts and applying the appropriate TTP, battle staffs can recommend the actions required to protect the force.

This MTTP should be read in conjunction with other multiservice and Service NBC defense publications.

The primary audiences for this MTTP are tactical and operational NBC advisors and force planners. The focus is on NBC staff responsibilities in conducting operations in a contaminated environment. Information contained herein will help other national forces and other services plan and conduct multinational operations with US Army forces.

The proponent for this publication is the U.S. Army Chemical School. Send comments and recommended changes directly to Commandant, US Army Chemical School, ATTN: ATSN-CM-DD, 401 Engineer Loop, Suite 1029, Fort Leonard Wood, MO 65473-8926.

Unless this publication states otherwise, masculine nouns or pronouns do not refer exclusively to men.

Introduction

FM 3-11.3, NBC Contamination Avoidance, contains six chapters that provide multiservice doctrine for use in supporting planning and conducting NBC Contamination Avoidance.

Chapter 1 provides information on potential contaminants on the battlefield, vulnerability analysis and reduction, and principles of contamination avoidance.

Chapter 2 discusses NBC detection and identification. This chapter discusses cooperative detection, principles of detection and identification, and detection systems currently in use.

Chapter 3 outlines the principles of reconnaissance, surveillance, monitoring, and survey. A major portion of the chapter deals with NBC reconnaissance.

Chapter 4 provides information on industrial hazards that may be found on the battlefield. These hazards may result from release other than attack which can include collateral damage or intentional release.

Chapter 5 provides details on the NBC Warning and Reporting System and is based on the latest revision to ATP-45.

Chapter 6 provides details on models and modeling which may be used to predict the travel of an agent cloud.

Appendixes A-L provide supporting information for Chapters 1-5. Specifically:

- Appendix A outlines suggested Tactics, Techniques and Procedures for Nuclear Defense.

- Appendix B outlines suggested Tactics, Techniques and Procedures for Chemical and Biological Defense Operations.

- Appendix C outlines suggested Tactics, Techniques and Procedures for dealing with Release Other Than Attack (ROTA).

- Appendix D provides TTPs on NBC Sampling Operations.

- Appendix E outlines TTPs on NBC Intelligence Preparation of the Battlefield.

- Appendix F provides Procedures for using Operational Exposure Guidance.
- Appendix G outlines procedures for conducting NBC Surveys.
- Appendix H contains a glossary of terms used in this manual.
- Appendix I contains a list of acronyms used in this manual and their meaning.
- Appendix J contains references used in the development of this manual.

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Headquarters
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Washington, DC,

NBC/TIM Contamination Avoidance

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*This publication supersedes FM 3-3, 16 November 1992

Chapter 1

Contamination Avoidance

In fact, in most areas where U.S. forces could potentially be engaged on a larger scale, many of the most likely adversaries already possess chemical or biological weapons. Moreover, some of these states appear determined to acquire nuclear weapons. Weapons of mass destruction in the hands of a hostile regional power could threaten not only U.S. lives and U.S. interests but also the viability of its regional power projection strategy.

Secretary of Defense's Annual Report to Congress, February 1995

The possibility that an adversary will use NBC weapons against the U.S. and its allies increases daily. If these weapons are used, our forces must be ready to implement the principles of NBC defense. The first of these is contamination avoidance, which, if successful, may limit the need for individual and collective protective equipment or the need to conduct time and labor intensive decontamination activities.

In addition to the current arsenals of Nuclear, Biological, and Chemical weapons systems, almost all areas of the world have various types of factories, research facilities, pharmaceutical production lines, and power plants that contain large quantities of materials which may be hazardous when released into the atmosphere. Experiences with chemical release at Bhopal, Indiaand nuclear contamination release at Chernobyl, Ukraine, demonstrate that toxic industrial materials (TIM) can be just as hazardous as military weapons. Release other than attack (ROTA) of these TIM, either intentionally or because of collateral damage, is a potential challenge for our forces.

SECTION I - OVERVIEW

Contamination Avoidance is defined as taking actions to avoid or reduce the effects of an NBC attack and to minimize the effects of NBC or toxic industrial material (TIM) contamination hazards. There are both active and passive measures that can be taken to avoid contamination. Passive defense measures include those measures taken to avoid being targeted and hit by any other weapons system. These include OPSEC, camouflage and concealment, hardening positions, and dispersion of service members and equipment. NBC specific passive measures include warning and reporting of NBC/TIM events; locating, identifying, tracking, and predicting NBC/TIM hazards; and limiting exposure to NBC/TIM hazards. Active defense measures include ballistic mssile defense systems and interception of covert delivery systems.

Contamination avoidance plays a major role in overall NBC defense. The three fundamentals of NBC defense – contamination avoidance, protection, and decontamination, executed at all levels, coupled with an effective retaliatory response, will increase the likelihood of U.S. victory. NBC defense is included within the principles of **Sense** the environment, **Shape** the battlespace, **Shield** the force, and **Sustain** operations. NBC surveillance, detection and identification of hazards, monitoring for contamination, and conducting reconnaissance are all part of the sensing principle. Each of these activities is a necessary part of avoidance and will be covered in more detail later in later chapters of this manual.

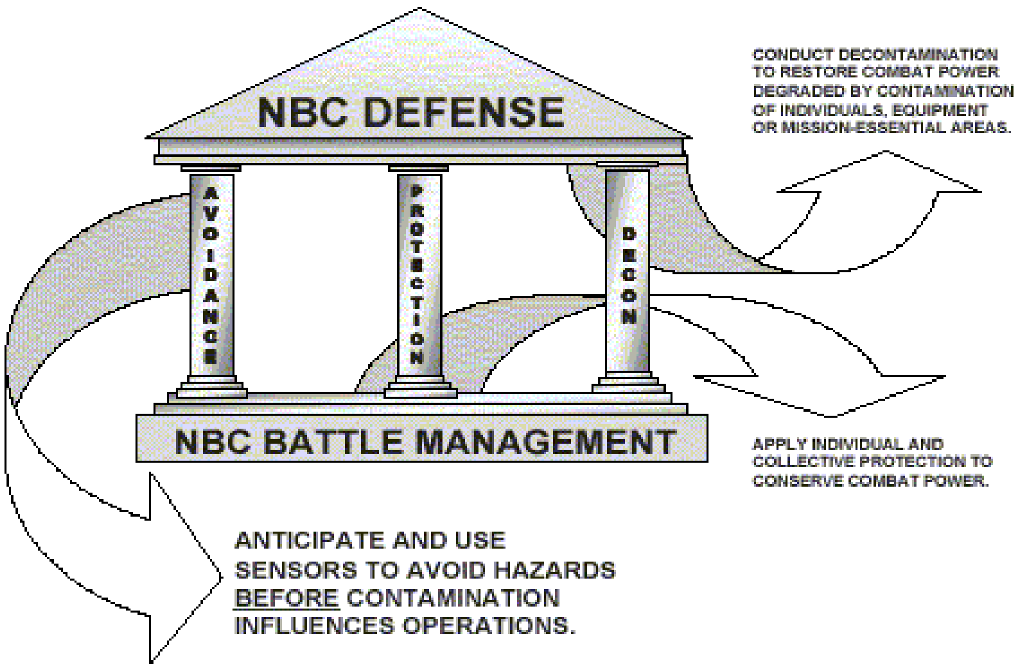

Figure 1-1 Principles of NBC Defense

- Sensing the environment. Sense is the key enabler to shaping NBC Defense and allows the force to avoid the hazard or enhance protective posture if avoidance is not possible. Sensing includes detection of trace fugitive emission (e.g., production facilities or transportation of munitions/materials) prior to employment. Most units are equipped with hand-held and remote automatic alarms, hazard monitors, and detector kits. Significant warning improvements will evolve from the ability to interconnect many of these detection devices through the Joint Warning and Reporting Network (JWARN). NBC reconnaissance systems provide more sophisticated detection, identification, and sampling equipment.

- Shaping the battlespace. Shaping is the orchestration of NBC defense to optimize the organization of the battlespace for accomplishing the mission despite the presence, or threat of NBC agents. Shaping the battlespace provides NBC visualization. NBC visualization is the process where the commander develops a clear understanding of the current and predicted NBC situation. The commander can then envision the end state (mission accomplishment while minimizing NBC casualties), and visualize the sequence that moves the commander's forces from its current state to the end state (Contamination avoidance, protection, and decontamination).

- Shielding the force. Shielding the force prevents NBC casualties by reducing the threat, avoiding contamination, physical protection, and medical pretreatment. Emerging NBC defense technologies will enhance shielding capabilities and allow the commander to use "science" to achieve NBC focused defense. The goal is to increase Mission Oriented Protective Posture only for units affected by an NBC event.

- Sustaining the force. Despite avoidance efforts, units may become contaminated either by direct attack or by movement through a contaminated area. Sustaining the force includes effective medical treatment and decontamination in order to fully restore combat power.

While avoiding contamination is always desirable, mission requirements will not always allow avoidance. The mission may force individuals and units to either occupy or cross a contaminated area. Units can minimize their perfomance degradation by following the principles and procedures outlined in this manual.

The doctinal tenets of contamination avoidance are sound and can be applied to all situations at all levels. The tactics, techniques, and procedures (TTP) of applying contamination avoidance will vary according to mission and the environmental conditions. For example, the TTPs applied to a large fixed facility such as an airfield will differ from those selected for a mobile unit as well as with the time of year.

Contamination avoidance begins with a knowledge of the hazards that may be encountered. This includes the physical characteristics, field behavior, and employment techniques that may be used. A thorough intelligence preparation of the battlespace (IPB) is also essential to avoidance. Understanding the threat's NBC capabilities and delivery systems allows the JTF commander to employ the assets necessary to protect the force and to emplace the sensor array necessary to implement the NBC warning and reporting system.

SECTION II – POTENTIAL CONTAMINANTS

NUCLEAR WEAPONS

Nuclear weaons are similar to convential weapons in that their destructive power is due to blast and shock. However, the nuclear explosion is generally hundreds of times more powerful than the conventional weapon explosion. In addition, a nuclear burst will also produce large amounts of thermal radiation (heat), nuclear radiation (initial radiation and fallout), and electromagnetic pulse (EMP). Each of these effects require protective measures; however, only the radiation produces contamination which remains in the battlespace.

The damage and contamination effects vary with the location of the point of burst in relation to the earth's surface. For purposes of definition the main burst types are (1) air (explosion below 100,000 feet but fireball does not touch the earth's surface), (2) high altitude (above 100,000 feet), (3) underwater, (4) underground, and (5) surface (fireball touches the earth's surface. The discussion in this manual will focus on air and surface bursts and their effects on military operations. The following effects will be produced by air or surface bursts:

- Blast (shock). A high pressure wave is produced a fraction of a second after the detonation. This wave moves rapidly outward in all directions from the fireball and acts basically like a moving wall of compressed air. If the detonation is an airburst, a portion of the blast wave will be reflected off the surface of the earth in a manner similar to a sound wave producing an echo. The reflected wave will also move outward and eventually catch up with and reinforce the original wave. This reinforcing of waves is called the "Mach effect". Damage from the shock wave is caused by both dynamic and static pressure. The "dynamic" pressure produces high winds that knock down structures and carry debris. Small pieces of debris carried by high winds act like missiles that can penetrate deeply into even hard materials like concrete. The "static" pressure is also called overpressure and can reach levels that are several times normal atmospheric pressure. The overpressure has the effect of crushing structures and buildings; however, the human body is fairly resistant to overpressure although ruptured eardrums can be caused by the overpressure.

- Thermal Radiation. About 35-40 % of the energy from a normal airburst is emitted as thermal radiation. This thermal radiation can cause considerable damage by igniting combustible materials and creating fire hazards. In addition, the thermal radiation is capable of causing skin burns and eye injuries even at distances beyond those at which fuels are ignited. Flash burns can be caused by absorption of thermal radiation by the skin. Permanent eye injury or blindness may be caused by looking directly at the fireball, but temporary loss of visual acuity (flash blindness or dazzle) caused by extreme brightness will be more common, especially at night. Pilots will be especially at risk to flash blindness.

- Initial Nuclear Radiation. Initial nuclear radiation refers to the radiation released within 1 minute after the detonation. The major part of initial radiation consists of neutrons and gamma rays. Both types of radiation travel considerable distances and are able to penetrate shielding materials. High doses of initial nuclear radiation can cause incapacitation and death in humans. The neutron flux associated with the nuclear fission reaction will also react with air and soil atoms to produce induced radiation in the vicinity of ground zero. The radiation dose rate in these induced radiation areas can be quite high initially and is a consideration when planning surveys and reconnaissance. • Residual Radiation. Residual radiation is defined as that radiation which is emitted more than 1 minute after detonation. There are two major types of residual radiation, (1) fallout which includes fission fragments from the weapon itself and soil and other particles which were sucked into the fireball, and (2) neuton induced radioactivity in the soil, water,and other materials in the vicinity of ground zero. Fallout is divided into early fallout (within 24 hours) and delayed. While the early fallout will be most significant from an operational standpoint, all fallout will impact consequence management.

- Electromagnetic Pulse. Electromagnetic pulse or EMP is caused by the interaction of initial nuclear radiation with air atoms and molecules. An ionized region surrounds the area around ground zero and can damage electonic equipment which is not EMP hardened.

LOW LEVEL RADIATION (LLR) AND DEPLETED URANIUM (DU)

In addition to the nuclear weapon threat, there is also a potential for the release of low levels of radiation from other sources. This threat can occur due to damage to facilities that routinely use radioactive materials/sources such as hospitals or research centers. Other sources may include deterioration of nuclear power facilities, inadequate nuclear waste disposal, and terrorism. The total doses received from these types of exposures will be higher than background but will not exceed 70 cGy (RAD) (See Appendix for radiological units of measure. Unless there are alpha or beta particles present which could be inhaled or ingested, LLR will not cause immediate problems. However, over the longer term, LLR may contribute to the production of cancer causing cells. Leaders should take necessary steps to detect LLR and protect their personnel from it if possible. In many cases special RADIAC instruments that measure alpha and/or beta radiation will be required to assess the hazard. These are primarily long-term health hazards rather than operational considerations.

Depleted uranium is a by-product of nuclear fuel production and is essential a waste product. Uranium itself is a metal which is very dense and heavy (more dense than lead). It is malleable and ductile and can be rolled and drawn into rods, tubes, wires, and sheets. The main military use of DU is as a penetrator for antitank and armor piercing ammunition. DU is also found in some armor packages and may be used as a counterweight. The DU in these rounds does not present a significant hazard as long as the rounds are intact. However, there are hazards around vehicles which have been hit or destroyed by DU munitions. Leaders at all levels must take steps to protect their personnel from DU hazards. There major hazard with DU is its toxicity, but it can become an internal hazard.

- Heavy Metal Toxicity: Uranium is more toxic than lead and will cause poisoning if taken into the body. Care must be taken not to inhale or ingest the material when moving around in an area where a DU munition has exploded or where there is shrapnel contaminated with DU.

- Internal Irradiation: DU emits alpha particles, beta particles, and gamma radiation as it decays. While alpha and beta are relatively easy to shield outside the body, both can cause serious damage when inside the body. After the DU particle is inhaled or ingested, there is no shielding between the particle and the living cells. Follow the warnings and instructions from your DU hazard awareness training per service directives.:

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BIOLOGICAL AGENTS

Avoidance of biological agents requires and understanding of the properties of biological agents, the methods used for disseminating the agents, and the fate of the agent after dissemination. There are two broad categories of biological agents:

- Pathogens. Pathogens are infectious agents that cause disease in humans, other animals, and plants. There are about 100 naturally occurring pathogens that could potentially be used in biological warfare. They belong to the major groupings of fungi, bacteria, viruses, and rickettsia. These pathogens normally enter the body through the respiratory tract, the digestive tract, urinary tract, skin, or eyes and cause an infection. Most BW agents will be taken in by mouth and enter the lungs and digestive tract. Any form or protection that protects the individual from inhaling or ingesting the agent will enhance avoidance. While some infectious diseases can be fatal, the potential for hundreds or thousands of people being sick or incapacited and requiring care for a long period of time is also significant.

- Toxins. Toxins are poisonous substances produced by living organisms. Examples of toxins include botulism which is very toxic and can show up in improperly processed canned foods. These toxins may be lethal or incapacitating and desseminated in and act in a manner similar to chemical agents. Unlike pathogens, toxins do not reproduce or increase after entering the body.

Biological delivery systems have the potential to cover larger areas than any other type of weapon system. Tests conducted many years ago demonstrated that infective doses of pathogens can be disseminated over several thousand square kilometers by one aircraft. This capability to use small amounts of agent to cover vast areas makes biological warfare attractive to small countries or terrorist groups fighting against larger forces. Biological agents can also be delivered covertly or can be carried by vectors. Common vectors are mosquitos, lice, ticks, and fleas; all of these vectors can circumvent the protective mask by delivering the pathogen directly into the bloodstream.

Biological agents are dependent upon the weather and environment after dissemination. Most BW agents decay rapidly when exposed to the environment. An exception to this is the organism that causes anthrax. This bacteria has the ability to form a spore which is resistant to environmental breakdown and can survive several years as a spore. The spore can cause later problems through reaerosolization of the particle. In general, the following factors have an effect on BW:

- Direct ultraviolet (UV) rays from the sun will kill many BW agents. Therefore, you should expect most BW attacks in the late evening, night, or early morning. Air stability is usually favorable at this time and UV rays are minimal.

- Many pathogens prefer a high relative himidity and will die under conditions of low humidity. For those pathogens that might be disseminated in a dry form, low humidity would be optimal.

- Dissemination under a stable (inversion) temperature gradient is generally the most effective. Neutral and lapse conditions will allow more turbulence and mixing of the air layers and thus dilute the concentration of the agent.

Because of the variety of agents and delivery systems available, contamination avoidance in the biological realm is dependent on a careful, thorough, intelligence preparation of the battlespace (IPB) and early detection and warning of suspected attacks. Immunization against known or suspecte agents is also important. The medical intelligence system and epidemilogical procedures may be the keys to determining that a biological attack has occurred.

CHEMICAL AGENTS

Avoidance of chemical agents requires an understanding of the employment and physical characteristics of the agents. Agents are often classified by the effects that they have on the body. In this classification we have nerve, blister, blood, choking, psychochemical, and irritants. Agents are also classified by the time that they remain hazardous in the field – here we use the terms persistent and nonpersistent. For practical purposes, nonpersistent usually only creates a hazard for a period of hours while persistent create a hazard for days or weeks. Persistent and nonpersistent agents are employed tactically to achieve different objectives and detection, identification, and avoidance planning must consider this. Once again, a thorough IPB must consider threat doctrine for employment of chemical agents.

- <u>Persistent Agents.</u> Persistent agents produce long term contamination and are generally used for the following purposes:

  - Produce casualties among unprotected personnel.
  - Contaminate facilities and supply areas; contaminate fixed facilities such as ports and airfields.

- Restrict use of terrain and shape the battlespace.
- Degrade combat effectiveness by forcing long term protective posture.
- Delay or restrict movement.
-

- <u>Nonpersistent Agents.</u> Nonpersistent agents produce minimal contamination and are generally used for the following purposes:
  - Produce immediate casualties among unprotected personnel.
  - Degrade combat effectiveness by forcing protective posture.

TOXIC INDUSTRIAL MATERIALS (TIM)

In addition to classical agents, there are thousands of chemicals and other materials that are used in peacetime for industrial production or other processes. Many of these are hazardous and could produce casualties if released in large quantities. Industrial chemicals are produced in almost all countries and are transported throughout these countries by truck or rail. Accidents and release commonly occur during peacetime such as the previously discussed chemical accident in Bhopal, India, and the Chernobyl, Ukraine, nuclear plant incident.

In almost any military operation, the joint force is virtually assured to encounter some types of hazardous materials. If these materials are released, either intentionally or unintentionally (ROTA), the force must be able to detect the materials involved and take protective measures as outlined in Appendix _. A thorough IPB is essential to identify potential hazards. The IPB should consist of the following activities:

- Identify industrial plants, chemical storage sites, and railroad yards where chemicals might be awaiting movement.
- Identify chemicals routinely produced, used, or processed in the area.
- Identify any nuclear power plants or nuclear waste storage sites.
- Assess the probability that a deliberate release of TIM could occur.
- Assess the probability that military operations could cause a release due to collateral damage or other actions.

SECTION III – INTELLIGENCE PREPARATION OF THE BATTLESPACE (IPB)

Intelligence preparation of the battlespace is a systematic, continuous, process of analyzing threat capabilities and the battlespace environment in a specific geographic area. JP 2- 01.3 , *Intelligence Preparation of the Battlespace,* outlines this process in detail. IPB is designed to support staff estimates and military decision making. Applying the IPB process helps the commander selectively apply and maximize combat power at critical points in time and space on the battlespace by accomplishing the following tasks:

- Defining the command's operating environment and its effects on operations.
- Determining the threat's likely course of action (COA).

The IPB process is continuous. It begins prior to and during the command's initial planning for an operation and continues during the conduct of the operation.The IPB consists of the following four steps:

- Define the battlespace environment.
- Describe the battlespace's effects.
- Evaluate the threat.
- Determine threat COAs.

Each process function is performed continuously to ensure that IPB products remain complete and valid and support the commander through the current operation and future operations.

NBC IPB PROCESS

The NBC IPB process supports decision making. This process is covered in more detail in Appendix _.

- At the higher levels, massive amounts of data flow into the operations center. Data from sensors, surveillance assets, and other collection assets must be sorted, filtered, analyzed, and turned into information. NBC experts assist the intelligence staff in fusing information from all sources to produce the intelligence estimate that includes NBC considerations.

- The NBC estimate enables the commander and staff to gain understanding of enemy NBC capabilities and COAs, and to estimate NBC effects on the battlespace. This understanding of the situation provides situational awareness to anticipate future events and make sound, timely decisions. The NBC estimate is used in mission analysis, COA development, COA selection, wargaming, and OPLAN/OPORDER development.

- NBC experts also analyze and refine the All Source Production Section's threat COA models to show the enemy's options for employing NBC weapons. This analysis enhances contamination avoidance tactics, techniques, and procedures (TTP), and allows refinement of the NBC reconnaissance and surveillance plan.

- The NBC IPB is the basis for the following:

    - Assigning Nuclear, Biological, Chemical Threat Status (STANAG 2984)

- Analyzing Vulnerability
- Establishing Automatic Masking Criteria
- Conducting MOPP Analysis
- Directing NBC Protective Measures
- Task organizating and asset employment.
- Determining NBC Indicators and Warnings

[redacted]

Vulnerability analysis is a systematic method for estimating the consequences from a threat attack or a release of toxic industrial materials(ROTA). The NBC estimate drives the NBC vulnerability analysis based on the threat's capabilities and delivery systems. The products of the vulnerability analysis include the staff's recommendation on vulnerability reduction measures and the staff's assessment of the risk associated with the COAs for mission accomplishment. This analysis supports contamination avoidance, protection, and decontamination decisions. It directly impacts on positioning of detectors and establishing Warning and Reporting Systems.

- In general, it is best to conduct vulnerability analysis separately for nuclear, biological, and chemical weapons, low level radiation, and toxic industrial materials. Although there are many similarities, there are enough differences to make separate analyses necessary for each type of hazard. In addition, the threat forces may be limited in capability and not have all types of NBC weapons.

- <u>Nuclear vulnerability analysis</u> must consider all effects from a nuclear detonation. These include blast, thermal radiation, initial radiation, residual radiation (fallout), and electomagnetic pulse (EMP). Vulnerability is dependent on yield of the weapon, type of protection available to personnel attacked, and dispersion of the unit. Analysis includes the following:

  - Use current intelligence estimates to determine the yields of threat weapons and the delivery systems. Perform an analysis for each weapon yield.
  - Use current friendly force information to determine the disposition of friendly unit personnel.
  - Obtain the appropriate radius of vulnerability.
  - Estimate the fractional coverage for each type of target.
  - Recommend ways to decrease vulnerability and increase protection.

- Biological Vulnerability Analysis depends on the IPB to determine the delivery systems and agents available to the threat. Does the threat have the capability to cover large areas or will attacks be primarily terrorist or small scale? Will long lasting agents such as anthrax be used or will attacks use agents that decay quickly? Analysis includes the following:

  - Immunization status of personnel in relation to predicted agents.
  - Current protective posture of units within the theater.
  - Assess hygienic practices; are individuals provided means to bathe/cleanse regularly?
  - Determine the current or projected maneuver status of the unit.

  Recommend vulnerability reduction measures.

- Chemical Vulnerability Analysis is once again dependent upon threat capability in agents and delivery systems, and threat probability of using them. Analysis includes the following:

  - Determine the time periods of interest. These will be based on the commander's operational concept and situational variables.
  - Associate weather data with each time period of interest. Temperature, wind speed, and stability will be the most important factors.
  - Estimate delivery capability. The intelligence estimate should provide the threat's maximum capability and its likely delivery capability.
  - Generate effects information. Use available intelligence data to estimate determine probable targets and probable agent(s). Downwind hazard distances can be estimated using Appendix B to this manual.

- Toxic Industrial Materials Industrial chemicals and materials are available in quantities that dwarf the amounts of chemical warfare agents available. In almost any military mission, the force is likely to encounter some types of TIM. The ubiquitous nature of these materials require that staff planners be aware of these TIM and take measures to reduce the vulnerability of the forces. Analysis includes the following:

  - Identify the types of chemicals routinely used, processed, or produced in the area.
  - Identify industrial plants, storage sites, and shipment depots.
  - Identify any nuclear power plants or nuclear waste storage sites.
  - Identify any research facilities that might have quantities of potential biological pathogens or quantities of radioactive materials.
  - Determine if the political environment is conducive to TIM attacks and releases.
  - Make an assessment of the potential for deliberate release of TIM. Assess whether the threat would gain an advantage either through military casualties or civilian casulties.

- Determine whether the terrain and weather are favorable for overt or covert attack with TIM.
- Assess the capability of detection systems to work against the threat TIM. (Understand the limitatations of your detector.)
- Determine which friendly forces are operating in the area and what type of protection is needed if TIM are released.

Coordinate with civilian authorities such as host nation officials or government agencies as early as possible to gain information about the area of operation. This type of coordination should greatly improve the vulnerability assessment process.

SECTION V- BUILDING NBC SITUATIONAL AWARENESS

Future rquirements for NBC defense must contribute to the achievement of full dimentional force protection as envisioned by Joint Vision 2000. Currently, our ability allows us to incorporate existing sensors into a manual system with “humans in the loop”. Future artificial intelligence applications will reduce, but not eliminate, the human judgment requirements. Combining service capabilities, coalition partners, and available civil defense assets will into a standardized warning and reporting system provies the best opportunity to produce NBC awareness. The sensors collect data, the data is turned into information by using the NBC report formats, the information is processed into knowledge by experts who provide hazard predictions and contamination overlays, and the knowledge is used by commanders as the basis for understanding for subsequent planning and order development (See Figure 1-2).

The processing of data into information which is fused into knowledge and then used to make judgments which support a myriad of operational activities. Levels of protection can be established, MOPP ananalysis condcted, decon planning initiated, and NBC impact on various courses of action estimated. The concept of situational awareness requires the following:

- A common understanding of the commander’s assessment of the situation.
- the commander’s intent

The commander’s concept of the operation combined with a clear picture of friendly and enemy force disposition and capabilities.

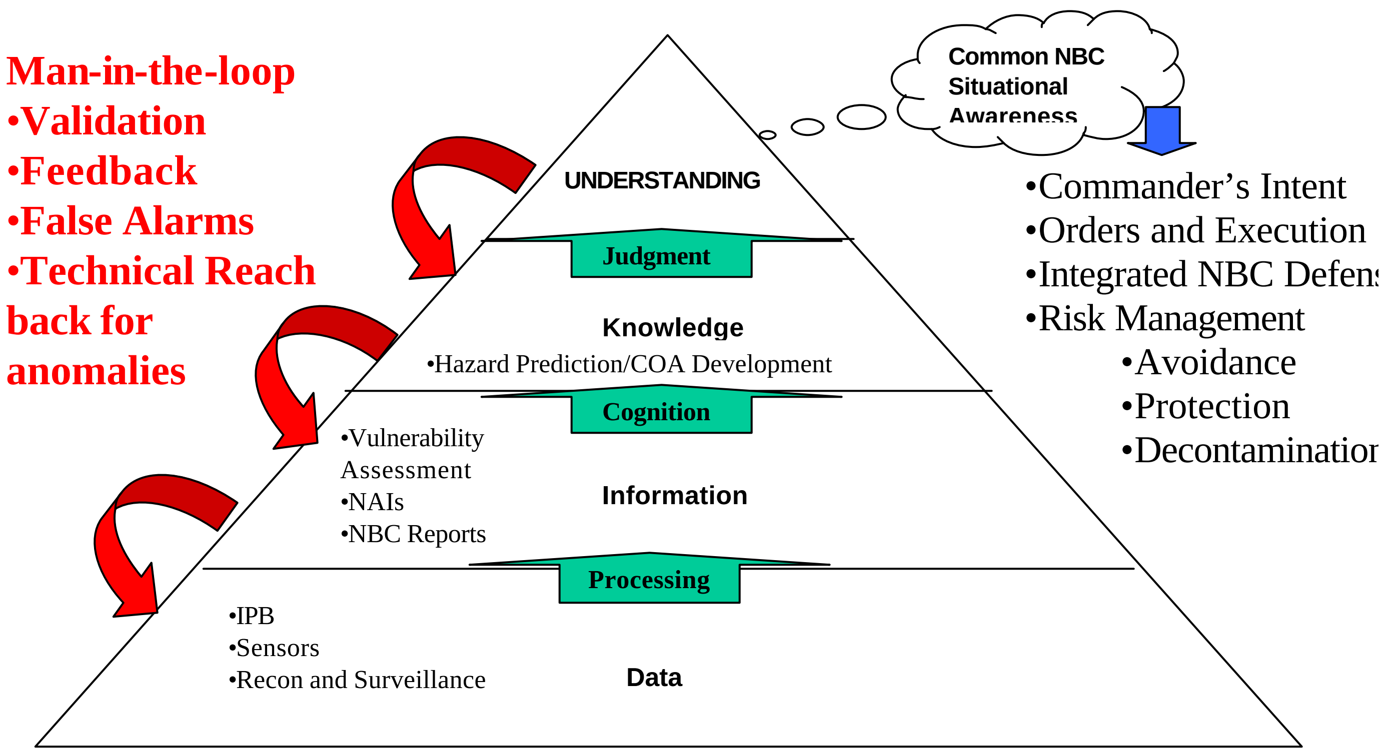


Figure 1-2 NBC Situational Awareness

2-3. Figure 1-2 outlines the hierarchy as data is processed into information which is then fused into knowledge. Knowledge promotes understanding which leads to a common, relevant situational awareness. Situational awareness requires the following:

- A common understanding of the commander's assessment of the situation.
- The commander's intent.
- The commander's concept of operation, combined with a clear picture of friendly and enemy force disposition and capabilities.
- Information operations assure situational awareness appropriate to every level of an organization down to the individual soldier.

2-4. Situational awareness of NBC/TIM hazards is a subset of the overall situational awareness of the battlefield and a subset of the "sense" element of combat power. Under most circumstances, the enemy can only contamintate a portion of the area of operations; therefore, the majority of units will spend most of their time under "clean" conditions. With networked detection, commanders can visualize the hazards and can then estimate the effects of the hazards on their operations. This allows the commander to keep his people out of protective equipment most of the time without increasing his risk.

2-5. The force HQ and staff must perform the following tasks to achieve NBC situational awareness:

- Know the NBC threat prior to the initiation of hostilities. This involves doing the homework necessary prior to deployment. As much information as possible about potential enemies should be gathered and stored by the NBC Staff and the Intelligence personnel.
- Develop indicators of imminent NBC use by adversaries. The entire_array of sensors and detectors from satellites to listening posts can then focus on observing and reporting these indicators.
- Identify potential NBC weapons prior to their release.
- Predict the impact/release point of incoming NBC weapons. All systems must be integrated for this to happen. An example is the Theater Ballistic Missile (TBM) defense system. Satellite sensors detect the launch of TBM, radars track the TBM, ground stations plot the trajectory and predict the impact point, and the JTF Operations Center warns component commanders. The component commander then uses detection teams/NBC recon assets to check the impact area for contamination.
- Know the weather conditions in the impact/release/hazard area.
- Develop a hazard estimate based on estimates of weapon performance and weather data. Appendices to this manual provide TTPs for hazard estimates and new automated systems will also perform this function.
- Know the location of joint force units.
- Selectively warn component commanders whose units fall within the hazard area. Component commanders are responsible for warning subordinate units within the hazard area.
- Notify component commanders of any long term hazard zones so that they can avoid contaminated areas or protect their force if avoidance is not possible.

2-6. NBC situational awareness shapes the battlespace and shields friendly forces from WMD hazards. In the past, systems and technology required individuals, in many cases, to report attacks and contamination through the use of the command nets using the NBC Warning and Reporting System (NBCWRS). This process is being automated through the development of the Joint Warning and Reporting Network (JWARN) which should be in the field by the time this manual is published. JWARN will provide the opeational capability to employ NBC warning technology which will collect, analyze, identify, locate, report, and disseminate NBC threat information. JWARN will be compatible with and integrated into Joint Service C4I2 systems. JWARN will transfer data automatically from the actual detector/sensor and provide commanders with analyzed data for decisions on disseminating warnings down to the lowest level on the battlefield. This automation and speed protects the force by increasing the time available to prepare for the hazard. JWARN will also expand the situational awareness on the battlefield and provide analyzed information for inclusion in the JTF common tactical picture.

2-7. Situational awareness of NBC hazards also requires an array of detectors that are linked together and cooperate with each other. The Ground Force (U.S Army and U.S. Marine Corp) has followed a strategy of using a large number of low sensitivity NBC point detectors (high density-low fidelity) cooperating with a smaller number of high sensitivity (low density-high fidelity) NBC identifiers (NBC Reconnaissance Units and Biological Detection Units) to maximize the Detect to Warn timelines. A large number of unit point sensors, a smaller number of standoff detectors, and the even small number of sensors associated with Unmanned Aerial Vehicle (UAV) and Unmanned

Ground Vehicle (UGV) can be linked to provide force protection. For purposes of protecting the force, distance equals time. The further out the hazard can be detected, the more time the individuals have to prepare for the hazard and to protect themselves from its effects.

Chapter 2

Detection and Identification

Enhanced situational awareness of NBC hazards will increase force readiness by eliminating the need to unnecessarily don protective equipment when no hazard is present, and will provide a warning of an actual NBC attack in sufficient time for soldiers to take protective measures.

Colonel Richard A. Jackson

This chapter addresses the need for shared information and a common tactical picture throughout the joint battlespace. The JTF must fully exploit information age technology in order to provide the most efficient use of limited resources to ensure protection of the force. Therefore, the focus must be on predicting and detecting NBC attacks, warning those units that may be affected by the attack, and detecting and identifying the contamination caused by the attack. Section I deals with Interactive Detection Networks, a methodology of linking all available intelligence and sensor systems in order to detect NBC attacks in sufficient time to take protective action. Section II deals with the principles of detection. Section III deals with detection systems and their employment.

SECTION I – INTERACTIVE DETECTION NETWORKS

2-1. The objective of any NBC hazard warning system is to detect the hazard and provide warning that a hazard is present. If the individual is warned and is able to take protective action prior to being affected by the hazard, the system worked. If the system sent a false alarm or did not provide a warning in time, the system failed. As will be seen later in this chapter, U.S. forces have numerous detectors and warning devices for NBC hazards. Each of these individual detectors has technological limitations. However, deploying an array of detectors and sensors and linking them together electronically provides synergy to the system and compensates for the technological weaknesses of any single sensor. When the NBC warning system is electronically linked to the JTF intelligence system, the theater missile defense system, and other theater collection assets, cooperative detection and synergy is achieved. Interactive detection networks allow the JTF commander to increase his situational awareness by "seeing" agents that no single detector could detect with minimal probability for a false alarm. As a result, the JTF HQ can rapidly transmit NBC warnings to units in the hazard envelope. Interactive detector networks are a future capability, not a current reality.

2-2. Interacive detection networks require fusion of data coming from the NBC sensor/detector array, the JTF intelligence systems, the theater missile defense system, and other collection assets such as JSTARS and AWACS. Fusion can occur wherever sufficient data and information is available; however, in the JTF, a Joint Intelligence Support Element Assessment Cell (JAC) can be formed to perform this task. The JAC's function is to maintain operational awareness of the battlespace by constantly fusing and assessing all friendly and enemy information. The JAC accomplishes this mission using the following procedure:

- The current operations cell reports friendly information to the JAC. The current intelligence cell reports enemy information. Both cells continuously report confirmed, accurate, filtered, processed and categorized information.
- "Subanalysis" by the JAC fuses friendly information with enemy information for each warfare area.

Analysis of the subanalyses in aggregate produces a complete, thorough assessment and an accurate situational awareness.

2-3. Figure 2-1 is taken from FM 101-6, *Information Operations*, and outlines the hierarchy as data is processed into information which is then fused into knowledge. Knowledge promotes understanding which leads to a common, relevant situational awareness. Situational awareness requires the following:

- A common understanding of the commander's assessment of the situation.
- The commander's intent.
- The commander's concept of operation, combined with a clear picture of friendly and enemy force disposition and capabilities.

Information operations assure situational awareness appropriate to every level of an organization down to the individual soldier.

2-4. Situational awareness of NBC/TIM hazards is a subset of the overall situational awareness of the battlefield and a subset of the "sense" element of combat power. Under most circumstances, the enemy can only contamintate a portion of the area of operations; therefore, the majority of units will spend most of their time under "clean" conditions. With cooperative detection, commanders can visualize the hazards and can then estimate the effects of the hazards on their operations. This allows the commander to keep his people out of protective equipment most of the time without increasing his risk.

2-5. The Joint Force HQ and staff must perform the following tasks to achieve NBC situational awareness:

- <u>Know the NBC threat prior to the initiation of hostilities.</u> This involves doing the homework necessary prior to deployment. As much information as possible about potential enemies should be gathered and stored by the NBC Staff and the J2.
- <u>Develop indicators of imminent NBC use by adversaries.</u> The entire array of sensors and detectors from satellites to listening posts can then focus on observing and reporting these indicators.

- Identify potential NBC weapons prior to their release.
- Predict the impact/release point of incoming NBC weapons. All systems must be integrated for this to happen. An example is the Theater Ballistic Missile (TBM) defense system. Satellite sensors detect the launch of TBM, radars track the TBM, ground stations plot the trajectory and predict the impact point, and the JTF Operations Center warns component commanders. The component commander then uses detection teams/NBC recon assets to check the impact area for contamination.
- Know the weather conditions in the impact/release/hazard area.
- Develop a hazard estimate based on estimates of weapon performance and weather data. Appendices to this manual provide TTPs for hazard estimates and new automated systems will also perform this function.
- Know the location of joint force units.
- Selectively warn component commanders whose units fall within the hazard area. Component commanders are responsible for warning subordinate units within the hazard area.
- Notify component commanders of any long term hazard zones so that they can avoid contaminated areas or protect their force if avoidance is not possible.

2-6. NBC situational awareness shapes the battlespace and shields friendly forces from WMD hazards. In the past, systems and technology required individuals, in many cases, to report attacks and contamination through the use of the command nets using the NBC Warning and Reporting System (NBCWRS). This process is being automated through the development of the Joint Warning and Reporting Network (JWARN) which should be in the field by the time this manual is published. JWARN will provide the opeational capability to employ NBC warning technology which will collect, analyze, identify, locate, report, and disseminate NBC threat information. JWARN will be compatible with and integrated into Joint Service C4I2 systems. JWARN will transfer data automatically from the actual detector/sensor and provide commanders with analyzed data for decisions on disseminating warnings down to the lowest level on the battlefield. This automation and speed protects the force by increasing the time available to prepare for the hazard. JWARN will also expand the situational awareness on the battlefield and provide analyzed information for inclusion in the JTF common tactical picture.

2-7. Situational awareness of NBC hazards also requires an array of detectors that are linked together and cooperate with each other. The Ground Force (U.S Army and U.S. Marine Corp) has followed a strategy of using a large number of low sensitivity NBC point detectors (high density-low fidelity) cooperating with a smaller number of high sensitivity (low density-high fidelity) NBC identifiers (NBC Reconnaissance Units and Biological Detection Units) to maximize the Detect to Warn timelines. A large number of unit point sensors, a smaller number of standoff detectors such as the M21 on the NBC Recon Vehicle, and the even small number of sensors associated with Unmanned Aerial Vehicle (UAV) and Unmanned Ground Vehicle (UGV) can be linked to provide force protection. For purposes of protecting the force, distance equals time. The further out the hazard can be detected, the more time the individuals have to prepare for the hazard and to protect themselves from its effects.

SECTION II – PRINCIPLES OF DETECTION AND IDENTIFICATION

2-8. Contamination avoidance requires that the hazard be detected and identified. The NBC warning and reporting system provides some of this information and commanders can also use unit detection teams to locate contaminated and clean locations in their areas of operation. A typical unit organization (squadron, ship, company) is equiped with automatic chemical alarms, chemical agent monitors, chemical agent detector kits, and detector paper (high density-low fidelity) which can provide presumptive identification. Dedicated NBC reconnaissance units are equiped with more sophisticated detection and identification equipment. There are at least five separate CB detection and identification tasks.

- <u>Detect/ID to Warn.</u> Standoff detection is generally the optimum because it gives units minutes to hours of warning prior to a potential encounter with NBC hazards. This warning allows the unit to either avoid the encounter or to reduce the hazard's effects on unit operations through preparation/protection and prophylaxis.
- <u>Detection for Treatment.</u> Detection for treatment focuses on identifying the type of agent dispersed in an attack so that the best possible treatment can be rendered as early as possible. Since some aspects of treatment are agent specific, identifying specific classes of agents is important.
- <u>Detection for Verification.</u> Detection for verification provides critical information to the National Command Authority (NCA) to support decisions regaring national strategic direction and integration. The NCA uses such information to determine the need for response and to select options for a response. The intelligence officer is responsible for the overall process involving evacuation of samples for analysis.
- <u>Detection for All Clear.</u> Detection for all clear (dewarning) means detecting the reduction of the hazard to acceptable levels. Comparison with methods and results from earlier detections of agent(s) will be important in determining all clear.
- <u>Detection for Surface Contamination.</u> Detection for surface contamination means detecting contamiantion deposits on surfaces. Examples of this could be checking equipment to determine if decontamination is necessary, or checking soil surfaces to determine if bypass routes are required.

SECTION III– DETECTION SYSTEMS

2-9. Chemical and biological agents will normally be delivered either directly on the unit positions (on target attacks) or upwind from the unit so that the agent will be carried to the unit on the wind (off target attacks). Detection methods will differ for each type of attack. For on target attacks, detector papers, M256A1 kits, and the chemical agent monitor will the major items used for detection and identification. For off target attacks, the Automatic Chemical Agent Detector and Alarm (ACADA) or the MICAD (Multipurpose Integrated Chemical Agent Detector) will be the main items used for detection. In the case of release other than attack, the TIM may be released within the unit area or some distance away from the unit and drift on the wind.

2-10. Biological agents will normally be released upwind of the target area and drift downwind to the target. Detection of bio agents is complex and is done by specialized Biological Integrated Detection System (BIDS) companies for the ground force and Portal Shield specialists for the U.S. Navy and Air Force.

2-11. Radiological detection and identification is accomplished with RADIAC instruments which are the basically the same for all forces.

Multiservice Detection Systems

Chemical Detection

2-12. Automatic Chemical Agent Detector and Alarm (ACADA)

- The M22 Automatic Chemical Agent Detector and Alarm (ACADA) replaces the M8A1 detector and alarm. The ACADA has the capability to detect nerve agent vapors GA, GB, GD, VX, and blister agent vapors HD, and L. The ACADA can be used in a stationary mode upwind from the area to be protected, can be vehicle mounted, and can be used inside collective protection shelters to monitor for contamination. **NOTE: <u>the ACADA is not certified for shipboard use.</u>**

- In the fixed mode, the ACADA is employed upwind of the area to be protected. The detector should be placed 150 meters upwind of the area to be protected unless circumstances do not permit. In any event, the detector unit should never be placed more than 400 meters from the alarm unit; otherwise, the electrical signal from the detector may not be strong enough to sound the alarm unit. The optimum spacing between detectors is 300 meters; this reduces the risk that a chemical agent cloud will drift between the detector without sounding the alarm.

- The number of alarms needed to protect a unit depends on unit size. The larger the unit front, the more detectors are needed. **NOTE**: *In this case, front means the upwind edge of the unit. Front could mean the left or right flank or the forward or rear edge of the unit.* Table X-X gives an estimate of the number of detectors needed for fixed employment of the detector.

- The actual position for each detector is determined by the commander with advice from the unit NBC expert . Figure 2-3 shows how an actual employment might look. Note how the detectors are positioned and how the position changes when unit position and wind direction changes.

NOTE: *When emplacement is completed by your unit, show the position of each detector on the range card. In addition, a strip of engineer tape may be placed on the detector so that it can be located during periods of limited visibility.* When the unit moves to a new location, the detectors must be retrieved and prepared for the movement. Unit personnel must know where the detectors are located (range cards) and when to retrieve them.

- The wire connecting the detector unit to the alarm unit is a critical element in ensuring that the unit is protected. Bury the wire to protect it from indirect fire. Check the wire periodically –every 4-6 hours- to insure that it has not been cut or broken.

- The ACADA can also be used on the move. Most tactical vehicles have mounts for the ACADA.

2-13. Improved Chemical Agent Monitor

- The Improved Chemical Agent Monitor (ICAM) is a hand-held device used for monitoring chemical agent contamination on people and equipment. It provides instantaneous feedback of chemical hazards and the level of hazard. The ICAM detects vapors of nerve and blister agents but will not detect liquid chemical agents. The ICAM has two operating modes selectable by means of a G/H switch. In the G mode, the ICAM monitors for G-series and V-series nerve agents. In the H mode, ICAM monitors for blister agents. TM 3- - - - has additional information on the operation of the ICAM. **NOTE: <u>the ICAM is not certified for shipboard use.</u>**

- Prior to monitoring people or equipment for contamination, it is essential that the monitor establish a background level with the ICAM. This is accomplished by turning the ICAM on and reading the display bars after a short period of time. The operator can then begin to monitor people, vehicles, aircraft, or other equipment. If the operator obtains a reading higher than background level, then the person or object is contaminated. If the reading is the same as background, the object may be contaminated or the ICAM may be reading the background vapor hazard. ICAM display bars are shown in Figure ---.

- There are several vapors which may cause false responses from the ICAM under some circumstances. These false responses are most likely to occur when sampling near strong vapor sources or when sampling in enclosed areas.
- <u>Aromatic Vapors.</u> Materials such as perfumes and food flavorings may cause false responses. Some brands of after shave or perfume may cause a response in the G mode if the ICAM is held close to the area where these items were applied. Peppermints, cough lozenges, and menthol cigarettes can cause a response in the H mode if exhaled near the ICAM inlet.

- Cleaning Compounds. Some cleaning compounds and disinfectants contain additives that give them a pleasant smell. Some of these additives such as menthol and methyl salicylate will give a false response in the H mode. Ammonia, on the other hand, will give a false response in the G mode. Because cleaning materials are spread over large surface areas, they will be a major source of vapors particularly in enclosed areas.
- Smoke and Fumes. The exhaust from some rocket motors and the fumes from some munitions ca give responses. Since it is unrealistic to be monitoring in these situations, there should be few problems in this area. Other potential interfernts are listed in Table ---.

- If you suspect the that the ICAM is giving a false reading, take the following steps:
  - Remain masked.
  - Remove and discard the filtered nozzle standoff and place the nozzle protective cap assembly on the front of the ICAM case to reestablish a clean air background.
  - Remove nozzle protective cap assembly and put on a new filter. If the false response reoccurs, the ICAM may not be operable in the area. Remove the source of the interferent if possible or replace the nozzle protective cap and remove the ICAM from the area.

2-14. M256A1 Detector Kit.

- The M256A1 Chemical Agent Detector Kit is capable of detecting both liquid and vapor concentrations of chemical agents. The M256A1 will detect nerve agents (both G and V Series), Blister (both H and Lewisite), and blood agents. Each kit consists of 12 disposable sampler-detectors, one booklet of M8 Paper, and a set of instruction cards attached by a lanyard to the plastic carrying case.

- M256 A1 samplers/detectors are used primarily to determine the type of chemical agents present. If the unit believes an attack has taken place or the alarm has sounded, the M256A1 kit is used to check for the presence of a chemical agent and to identify the agent. The M256A1 is also used to determine when and if it is safe to remove the protective mask.

- The M256A1 kit may cause OPSEC problems during times of limited visibility. White light is needed to properly read both the M8 Paper and the sampler/detector. Individuals should shield the light from enemy observation by using a poncho or other suitable covering.

- The M256A1 kit is issued at small unit level giving them the capability to detect and classify chemical agents.

2-15. ABC M8 Detector Paper

- ABC-M8 Chemical Agent Detector Paper is used to detect liquid chemical agents. A booklet of ABC-M8 Detector Paper is in the mask carrier. Each booklet contains 25 sheets of detector paper which changes color when it touches a chemical agent. The inside cover of the booklet has a chart that shows the colors and the type of agent that is present. V-type nerve agent turns the paper dark green; G-type nerve agent turns the paper yellow; and blister agents turn the paper red.

- Night operations cause problems when using the M8 Paper. The paper must be read in white light in order to see the color changes. During night operations, the paper can be brought into a white light area for reading. Users should be careful not to carry contaminated M8 paper into clean or uncontaminated areas. During night reconnaissance operations, the monitor can take several samples, mark them, and then bring them back to the vehicle for reading.

- Use M8 Paper by blotting the liquid droplets on the suspected contaminated surface. Never rub the paper against the surface because rubbing produces false positive (red) streaks.

2-16. M9 Detector Paper

- The M9 detector paper is the easiest and most widely used method for detecting chemical agents. M9 paper is more sensitive than M8 paper and reacts more rapidly as well. It turns red or reddish brown when it comes in contact with a chemical agent.

- M9 Paper comes rolled in a box and is generally used as a loop or ring around the object to be monitored. M9 paper is used on people by attaching a ring of it around the lower left sleeve, the upper right sleeve, and on one lower leg of the overgarment. M9 paper can also be used to monitor equipment by attaching it directly to the entrance to vans/shelters etc., or to other large pieces of equipment. If you attach the M9 paper to equipment, be sure to place it in an area free from dirt, grease, or oil. Petroleum products will also cause the paper to change color.

- As with the M8 paper, night operations will cause some problems with the M9 detector paper. Color changes will not show up when a flashlight with a red filter is used to read the paper. In those areas where using white light can cause OPSEC problems, commanders must establish procedures for checking the M9 paper. These procedures could include rotating soldiers into a white light area or collecting the M9 paper from frontline troops and reading it in a more secure area.

- M9 paper is especially useful for detecting on target attacks and for keeping soldiers from entering contaminated areas. Whenever pink, red, reddish-brown, or purple color appears on the paper, soldiers should suspect the presence of chemical agents and take action to protect themselves. The presence of chemical agents should be confirmed with the M256 kit.

2-17. M272 Water Testing Kit

- The M272 Water Testing Kit is a lightweight portable kit that will detect and identify harmful amounts of chemical warfare agents in either raw or treated water. The kit will detect cyanide (AC), mustard (HD), Lewisite (L), and nerve agents (G,V). Water containing quantities of agent less than the detecting capability of the kit is permissible for short-term use (up to 7 days) with up to 5 quarts per person per day usage. The M272 kits are usually found in chemical reconnaissance units, medical units, and units with a water purification mission.

U.S. Army Systems

Chemical Detection

2-18. FOX, M93A1, NBC Reconnaissance System

The M93A1 Fox is a U.S. Army improved version of the German TPZ1 Fuchs and is a fully integrated NBC reconnaissance system. It detects chemical contamination in the immediate area through point detection and contamination at a distance through the use of the M21 RSCAAL standoff detector. It automatically integrates contamination information from its sensors with input from its on-board navigation and meteorological systems and rapidly transmits the data to the Maneuver Control System. The crew compartment has an NBC collective protection system which keeps the working area free from contamination.

The Integrated NBC detection system has the following key components:

- Mobile Mass Spectrometer (MM1): The MM1 system consists of an air/ground detection probe and a microprocessor. The system can monitor for and identify all known chemical agents.
- M21 RSCAAL Standoff Detector: The M21 can detect chemical agent clouds at distances up to 5 km. This greatly reduces the time required to conduct surveys for chemical agents.
- Multipurpose Integrated Chemical Agent Alarm (MICAD): The MICAD is an NBC warning and reporting system which will be integrated into combat vehicles, vans, and shelters. The MICAD will detect chemical and radiological contamination, automatically generate NBC-1 and NBC-4 reports, and transmit the reports over existing tactical communications networks.
- Global Positioning System:
- NBC Marking Equipment: The vehicle has an NBC Marking Kit with an air-lock glove port which allows the NBC contamination markers to be positioned.
- NBC Sampling Equipment: Consists of a sample-collecting device with transport container. Has rubber glove protection for collecting samples.

During offensive operations, the FOX should be positioned well forward just behind the leading combat elements to facilitate contamination avoidance by the combat forces. During defensive operations, the FOX should be used to conduct NBC reconnaissance operations in the rear areas to ensure that the routes from the brigade, division, and corps support areas are free from NBC contamination. The FOX systems are also used to find clean fallback positions for the fighting forces during withdrawal and retrograde operations. Chapter 3, Reconnaissance and Surveillance Planning, has more information on Fox employment.

U.S. Navy Systems

Chemical Detection

2-19. Chemical Agent Point Detection System (CAPDS)

Shipboard Chemical Agent Point Detection System (CAPDS) is a fixed system capable of detecting nerve agents in vapor form using a baffle tube ionization spectrometer. CAPDS obtains a sample of external air, ionizes airborne vapor molecules, and collects them on a charged plate after eliminating lighter molecules via the baffle structure. When sufficient ion mass is collected, a pre-set potential is achieved, generating an alarm signal that is sent to Damage Control Central and the Bridge. The system is installed in an upper superstructure level and provides ships with the capability to detect nerve agents. The system will be activated when ships enter high threat areas and during operations in littoral waterways.

2-20. Improved Point Detection System (IPDS)

Improved (Chemical Agent) Point Detection System (IPDS) is an Ion Mobility Spectroscopy (IMS) based point chemical detection system with an algorithm library and embedded data processing. This system automatically detects and alarms to nerve and blister agent vapors at low concentrations and has the capability of rejecting common shipboard interference. IPDS consists of port and starboard external air sampling and detector units, a Control Display Unit (CDU) located in DCC, and a Remote Display Unit (RDU) located on the Bridge. IPDS will be deployed as part of the CB detection suite aboard ships

2-21. Chem-Bio Threats Directional Detector (AN/KAS-1A)

Chem-Bio Threats Directional Detector (AN/KAS-1A) is a Forward Looking Infrared (FLIR) based electro-optic sensor which remotely detects the presence of nerve agents. The AN/KAS-1A images the IR portion of the electromagnetic spectrum. A series of optical filters are actuated by the operator to determine if suspicious objects in the field of view are, in fact, chemical agent clouds. The AN/KAS-1A also has a remote video hook up to allow monitoring and recording of the field of view from a second location, typically the ship's Combat

Information Center (CIC). Directional bearings are displayed on the video image as well in the operator's view.

2-22. Shipboard ACADA

The shipboard ACADA is a portable miniature IPDS which is used to conduct shipboard surveys. It uses the same technology as the ACADA and has similar technical characteristics.

U.S. Air Force Systems

Chemical Detection

2-23. M90 Chemical Agent Detector

The M90 utilizes a small sealed radioactive source, AM-241, as a part of the detection system. The unauthorized repair or disassembly of the M90 may result in Alpha radiation contamination and exposure. The M90 Detector provides the Air Force with stand-alone nerve and blister agent detection. The M90 will detect nerve and blister agent vapors at levels that prevent over exposure to personnel. The M90 can be networked to provide airfield chemical detection and warning, as well as a shelter monitoring device. The M90 is a multi-application instrument which is capable of operating as a point detector to provide early warning of approaching toxic chemicals or as a chemical agent monitor to identify and monitor personnel, vehicles, and equipment for contamination. The M90 uses Ion Mobility Spectrometry (IMS) to determine the presence of toxic vapors. The detector is portable or can be vehicle mounted. The M22 detector will eventually replace this piece of equipment.

2-24. Automatic Liquid Agent Detector (ALAD)

The ALAD provides the user with automatic liquid chemical agent detection. ALADs are intended for use with existing vapor detectors. The AN/PSR-2 is an automatic liquid agent point detector capable of detecting solid or liquid chemical agent droplets as small as 200 microns in diameter within 60 seconds from contact onto the sensor disk. It can operate on internal battery power, or on 110/220 VAC and at 50 Hz line power as well. It is designed for local warning, using an integral horn and warning lamp, or for remote warning using a communications network. The unit provides the communications network with three signals: "operating and OK," "low battery," and "alarm".

Joint Systems

Chemical Detection

2-25. Joint Chemical Agent Detector (JCAD)

The Joint Chemical Agent Detector (JCAD) program will develop a combined portable monitoring and small chemical agent point detector for ship, aircraft, and individual warfighter applications. JCAD will automatically detect, identify, and quantify chemical agents. In addition, JCAD will provide a hand-held monitoring capability to the individual soldier, sailor, aircrew member, and marine. The device will be sufficiently sensitive to warn personnel of accumulation of a substantial chemical dose which would cause miosis or more serious effects, and be resistant to the severe interferent environment on a Naval vessel or on the battlefield.

2-26. Joint Service Lightweight Standoff Chemical Detector (JSLSCAD)

Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) is a small, fully automatic, standoff chemical agent detector. The unit is capable of on the move, real-time detection from either aerial or surface platforms. The unit will detect and alarm to a chemical agent cloud up to five kilometers away. The detector also provides chemical identification information and data for activation of countermeasures to avoid contamination. The JSLSCAD is equipped for visual and audible alarms and can display the agent class and relative position. This information is available locally and for transmission to battlefield information networks. JSLSCAD also has the capability to indicate an all-clear condition.

Multiservice Systems

Biological Detection

2-27. Portal Shield This program will demonstrate the military utility of an Air Base/Port Bio Detection capability and develop Concepts of Operations for that capability. The program will also demonstrate the following capabilities: Biological Warfare (BW) agent identification; sensitive equipment decontamination; contamination detection; and low cost commercial oro-nasal masks for protection against secondary hazards. The program will develop three systems, each with increasing automated capability. The Air Base/Port Bio Detection system will automatically detect BW aerosol attacks and generate Nuclear, Biological, and Chemical (NBC) warning reports. The BW sensor utilizes proven Navy technologies and components (e.g., Naval Medical Research Institute's hand-held assay tickets and several Navy Interim Biological Agent Detector (IBAD) components).

U.S. Army Systems

Biological Detection

2-28. Biological Integrated Detection System (BIDS)

The Biological Integrated Detection System (BIDS) is a multi-component system that provides monitoring and surveillance for biological attack, sampling of biological materials in the air, detection of biological agents, and presumptive identification of biological agents. Results of the biological detection and identification process are reported and biological samples are evacuated to sample transfer points.

Since any single technology can be expected to produce some false positives, the BIDS uses multiple technologies to monitor for biological agents. The BIDS components automatically count and size particles, determine if the particles are living organisms, determine some basic spore, cell, or toxin characteristics, and use antigen-antibody analysis for presumptive identification. The system will also automatically take samples required for definitive identification by a laboratory. Further information on BIDS capabilities and employment is available in FM 3-101-6.

2-29. Long Range Biological Standoff Detection System (LRBSDS)

The LRBSDS is a biodetection company asset that assists in providing early detection of a biological attack. The LRBSDS employs a laser system mounted in UH-60 helicopter to scan a designated area of interest and detect large man-made aerosols suspected of containing biological warfare agents. This provides a long range warning that a particulate or aerosol cloud is approaching. When LRBSDS data is combined with meteorological data and other supporting battlefield intelligence, the JTF commander can make the decision to give advance warning to units in the path of the cloud and to alert biological detection units in the path to go to a higher state of readiness.

U.S. Navy Systems

Biological Detection

2-30. Interim Biological Agent Detector (IBAD)

The Interim Biological Agent Detector (IBAD) will give the Navy an interim point detection capability aboard combatant ships as a near-term solution to a deficiency in detection, identification, and warning of biological agents. The IBAD is composed of a particle sizer/counter, particle wet cyclone sampler, manual identifier, and an improved membrane colorimetric ticket (flow-thru assay). The IBAD links to visual and audible alarms located locally and in Damage Control Central (DCC). IBAD automatically detects real-time change in environmental background for initial sample collection and alarm and provides agent identification within twenty minutes.

Joint Systems

Biological Detection

2-31. Joint Biological Point Detection System (JBPDS)

The Joint Biological Point Detection System (JBPDS) program will provide a common point detection capability for individual Service platforms and achieve joint interoperability and supportability. The detection suite will integrate an identifier, trigger, sampler, and detector for real-time detection and identification of biological agents. The suite will detect, in less than fifteen minutes, Biological Warfare (BW) agents at levels below the amount needed to impact combat effectiveness. The JBPDS will increase the number of agents that can be identified by the Biological Integrated Detection System (BIDS) and Interim Biological Agent Detector Systems. It will also decrease detection time; increase detection sensitivity; provide automated, knowledge-based, real-time detection and identification; and provide a first time point detection capability to the Air Force and Marine Corps.

Multiservice Systems

Radiological Detection

2-32. RADIAC Set AN/VDR-2

The AN/VDR-2 measures beat and gamma dose rates and has the additional capability of measuring total dose. The AN/VDR-2 is used to perform air and ground surveys and may also be used by individuals as a hand held instrument to monitor for radiological contamination on people and equipment. Installation kits are available to install the AN/VDR-2 in most military vehicles. The AN/VDR-2 set includes an audio and visual alarm that is compatible with vehicle NBC protective systems in armored vehicles, and interfaces with vehicle power systems and intercoms. The AN/VDR-2 is the main instrument used for radiological monitoring and survey.

2-33. RADIAC Set AN/UDR-13 (Pocket RADIAC)

The Pocket RADIAC set is a compact hand-held or pocket carried tactical RADIAC set capable of measuring prompt gamma-neutron dose from a nuclear event. The Pocket RADIAC set also measures gamma dose rate and gamma total dose from nuclear fallout. The set has audio and visual alarms that may be set at predetermined thresholds for both dose rate and total dose.

2-34. RADIAC Set AN/PDR-75

The RADIAC Set AN/PDR-75 provides a capability to monitor and record the exposure of individuals to gamma and neutron radiation. It measures prompt radiation from nuclear bursts(neutron and gamma), and total dose from nuclear fallout. The data from the AN/PDR-75 will be recorded for each individual and this data will be used to calculate unit radiation status. The data will also be used for medical triage and for unit reconstitution. This set provides the first capability to measure the individual’s total dose.

2-35. RADIAC Set AN/PDR-77

The AN/PDR-77 RADIAC Set is used mainly to detect and measure alpha radiation and low energy x-ray radiation. It can also detect and measure beta and gamma radiation. This is the primary RADIAC device to support the storage and movement of nuclear weapons, to respond to nuclear accidents, and to maintain Army equipment containing radioactive materials.

2-36. RADIAC Set AN/PDR-27

The AN/PDR-27 RADIAC Set is the U.S. Navy standard low range Beta/Gamma survey meter. Since the meter has a range of 0-55 mr/HR, it is mainly used for low intensity surveys and may also be used by individuals as a hand held instrument to monitor for radiological contamination on people and equipment. The instrument also has a headset which can be used so that the operator has both a visual and an audio cue that contamination has been found.

2-37. RADIAC Set AN/PDR-43

The AN/PDR-43 RADIAC Set is the U.S. Navy standard high range Beta/Gamma survey meter. The meter has a range of 0-500 R/HR, and is mainly used for high intensity surveys.

2-38. RADIAC Set AN/PDQ-1

The AN/PDQ-1 RADIAC Set is a multi-range Beta/Gamma survey meter. The meter has a range of 0-1000 R/HR, and can be used for both low and high intensity surveys. This instrument can also be used for personnel monitoring.

2-39. RADIAC Set AN/PDR-65

The AN/PDR-65 RADIAC Set is a the Navy standard fixed position Gamma dose rate/total dose meter. The meter has a range of 0-10,000 R/HR dose rate and 0-9,999 total dose.

2-40. Chapters 3 and 4 will provide additional information on how each of these detectors are used for surveillance, reconnaissance, and contamination avoidance.

Chapter 3

NBC Reconnaissance, Surveillance, Monitoring, and Survey

> *Contamination avoidance is essential for successful operations when faced with an NBC threat. Avoiding contamination allows units to maintain tactical momentum and preserves combat power by keeping soldiers out of increased NBC protective postures. It also removes or lessens the need for decontamination.*
>
> FM 100-5

The precise application of combat power and effective synchronization of maneuver and supporting fires require a fresh and accurate picture of the enemy's current dispositions and activity within the area of operations. Concentration of combat power, through maneuver, also depends on the ability to move swiftly and predictably. Consequently, the commander must know which routes and cross-country terrain are suitable to maneuver forces into decisive engagements with the enemy. NBC contamination of routes and terrain presents an obstacle to maneuver.

This chapter deals with the methods used to locate contamination and to provide contamination information to the commander. NBC reconnaissance is an active method to locate contamination, mark its boundaries, find bypass routes for maneuver units, and find clean areas for unit occupation. NBC surveillance is a passive measure taken to systematically observe a specific area for indications of an NBC attack. NBC monitoring is done to determine if a hazard is present. NBC surveys are specific missions assigned to units which require dedicated assets to delineate the boundaries of the contaminated area. While any unit with monitoring equipment can conduct a survey, they are normally assigned to Chemical Recon units. All of these efforts are important in developing he commander's common tactical picture.

SECTION I – PLANNING NBC RECONNAISSANCE AND SURVEILLANCE

3-1. Reconnaissance is undertaken to obtain information about the activities and resources of an enemy; or the meteorological, hydrographic, or geographic characteristics of a certain area. Surveillance is an activity which implies observing a specified area or areas systematically. NBC reconnaissance consists of various techniques and proceures designed to confirm or deny the presence of contamination at points, along routes, or within specified zones or areas. NBC surveillance involves the observation of key locations or areas to determine the existence of contamination. Contamination may be static (on the ground) or being transported by exixting winds. NBC reconnaissance and surveillance gain information about a specific type of hazard (contamination) but in general follow the same principles as other types of R&S. Planning NBC R&S is done as part of the overall R&S effort. There are three principles of NBC R&S: (1) Tell commanders what they need to know in time for them to act; (2) Do as much as possible ahead of time; and (3) Orient on the threat and how it coul impact on operations.

3-2 Intelligence preparation of the battlefield is step one in the planning process. As part of the wargaming process, the staff should template and wargame how, where, and when the enemy will use NBC weapons or cause a TIM release that could impact operations. The templated targets are included as named areas of interest (NAI) in the situation and event templates. The IPB and the commander's mission analysis identify the questions that need to be answered and when answers will be needed. These then become intelligence requirements (IR) and priority intelligence reqirements (PIR) that the intelligence officer uses to focus his collection efforts. The collection plan is an integrated and synchronized plan that selects the best collectors to cover each requirement. An extract from a collection plan with only the NBC PIR is shown at Figure 1. NBC experts help to develop those portions of the collection plan dealing with NBC NAIs. Indicators for each NAI are provided so that the collectors will know what to look for when perfoming reconnaissance or surveillance. For example, an indicator that chemicals may be used would be enemy movement of decontamination or recon vehicles forward. The Reconnaissance and Surveillance (R&S) Plan is a follow on to the Collection Plan.

PIR	INDICATORS	NAI	TIME		SPECIFIC ORDERS OR REQUEST	TASKINGS		
			NET	NLT		44 CHEM	2-1 CAV	1-87 INF
3. Will the enemy use NBC weapons and where & when ?	a. NBC detection equipment	32	2200	0900	check for chem	X		
	b. Movement of chemical munitions forward.	36	2200	0900	report activity	X		
	c. Movement of decon & NBCR vehicles forward.	20	2200	0900	report activity		X	
	d. Low order artillery bursts.	18	2200	0900	report activity			X

Figure 1. Sample Collection Plan

3-3. While the intelligence officer is responsible for driving the R&S effort, other staff officers also play in the process. The intelligence officer, the operations officer, and the staff must match the available reconnaissance and surveillance assets with missions in order to answer the commander's PIRs in a timely manner.

3-4. The NBC sections at each level of command and staff assist in the NBC Reconnaissance and Surveillance process. NBC recon units are scarce and their use must be planned carefully in order to maximize their effectiveness, i.e., get the maximum amount of information in the shortest amount of time. Working with the intelligence officer, NBC experts at the JTF/Corps level must assist in the following specific activities:

Translate the commander's PIR and IR into specific information requirements (SIR) and specific orders and requests (SOR). This translation answers the questions, "What to collect?" and "Who collects it?"

Analyze the NBC events on the event template to determine the NAI that require surveillance and/or reconnaissance. This analysis tells the staff how to position NBC recon assets (where they should go and when they should go there).

Identify the NBC collectors that are available and are capable of collecting the information. Not all collecting needs to be done by NBC recon units; for example, a scout platoon may be the best collector for information on whether the enemy is moving decon equipment forward or whether enemy forces are wearing protective clothing.

Task the collectors to perform the mission.

3-5. There are several strategies that can be employed to ensure that the greatest amount of information is collected in the shortest amount of time. These include augmenting, task organizing, cueing, and redundancy.

Augmenting and task organizing. All collection assets should be considered for task organizing to increase overall effectiveness and survivability. For example, the battalion or cavalry scout platoon my be task organized with the NBC recon platoon. While the NBC recon platoon performs NBC recon, the scout platoon performs tasks for which it is better equipped such as :

- Overwatch and security for the NBC Recon elements.
- Dismounted operations in concert with NBC recon.
- Reconnaissance of bypasses after a contaminated area is identified.
- Initial location of contaminated areas followed by handoff to the NBC recon platoon for detailed reconnaissance an marking.

Cueing may also be used as a strategy to make the best use of limited assets. For example, the scout platoon may conduct route and trafficability reconnaissance and look for NBC contamination. They then call the NBC recon platoon to find bypasses and to do detailed reconnaissance and marking.

Redundancy provides a back up system in case one asset breaks down. Redundancy guarantees continuous area coverage.

SECTION II – CONDUCTING NBC RECONNAISSANCE AND SURVEILLANCE

3-6. Commanders establish and coordinate missions, taskings, priorities, and command or support relationships based on recommendations by the NBC expert at each level of command. Planning for and conducting NBC reconnaissance at the unit level is based on the mission as defined in the operations order received from the requesting unit. FM 3-19 contains detailed information on planning recon missions and should be used as a guide. As a minimum, the following should be considered in planning and preparing for NBC reconnaissance operations:

Command or support relationships to ensure responsiveness to the supported unit.

Time and distance factors for the conduct of the operation.

Resupply activities to sustain NBC recon operations.

Security to protect the unit.

Fire support requirements.

Rules of engagement to prevent fratricide.

Possible locations for after mission decontamination.

3-7. NBC reconnaissance confirms or denies contaminated areas, or confirms that the area is clear of contamination. In performings these functions, the recon unit completes five critical tasks. These are to detect, identify, mark, report, and sample NBC hazards. Unit detectors will find the agent and make a presumptive identification. Samples can then be taken for laboratory analysis and definitive confirmation/identification. There are four types of ground NBC reconnaissance missions:

<u>Route reconnaissance.</u> Reconnaissance elements collect detailed information on a route. A route may be defined as a single road or it could be an axis of advance. The major tasks on a route rconnaissance include the following:

- Reconnoiter the route and locate any contamination.
- Report and mark all NBC hazards along the route.
- Locate and mark bypass routes if contamination is encountered.

<u>Area Reconnaissance.</u> Reconnaissance elements collect detailed information on a specific area. The directing HQ specifies the area boundaries and the information required. An area reconnaissance is typically assigned when employing a unit to reconnoiter a reported NBC attack area. The critical tasks on an area reconnaissance include the following:

- Reconnoiter all terrain within the area.
- Locate and mark all NBC NBC hazards within the area.
- Locate bypass routes around the contamination.
- Report all infromation.

Zone reconnaissance. Reconnaissance elements collect detailed information on a specific zone. A zone reconnaissance is a deliberate, time-consuming process that requires a alrge expenditure of resources. Typically, a zone reconnaissance is requested when the enemy situation is in doubt and when they need information on cross country trafficability. NBC zone reconnaissance is appropriate when there are indications or reports of NBC hazards, or intelligence/reports indicate a high probability of previous NBC attacks. An NBC zone reconnaissance is often directed in order to determine suitability for large unit (brigade or higher) assembly areas or logistics bases such as BSAs, DSAs, and CSAs. The critical tasks in a zone reconnaissance include the following:

- Reconnoiter all terrain within the zone.
- Locate all previously reported NBC attack areas and determine if a hazard still exists.
- Locate all contamination within the zone.
- Locate all commercial chemical production or nuclear facilities.
- Mark contaminated areas and locate routes to bypass contamination.
- Report all information.

Point reconnaissance. Reconnaissance elements collect NBC hazard information on a specific terrain feature or facility. Specific terrain features could include bridges, chokepoints, etc., while facilities could include factories or nuclear plants. The critical tasks in a point reconnaissance include the following:

- Reconnoiter the specific featurea and the area around it.
- Locate and mark all NBC hazards.
- Locate bypass routes if directe.
- Report all information.

NBC SURVEILLANCE

3-8. NBC surveillance is the systematic observation of specific areas to detect NBC attacks and hazards. Monitoring is a type of surveillance done by all units with NBC detectors. By operating detectors and alarms, units monitor their area for chemical attack. In addition, units begin monitoring with RADIAC instruments after a nuclear attack occurs. However, surveillance in the sense of reconnaissance and surveillance generally means observing a named area of interest (NAI) from a concealed position. An example of this would be an NBC reconnaissance vehicle performing surveillance on a bridge. The standoff detection capability of the M93A1 allows the vehicle to perform surveillance from up to 5 km away when visibility is good.

3-9. The use of Portal Shield at ports and airfields is another example of surveillance. Biological surveillance is also continuously performed by the Biological Defense Company and fixed detectors at some ports, airfields, and logistical bases. The biological detection systems perform their mission in the following manner:

- Monitor. Continuously monitors the air for any increase in number of aerosol particles within a certain size range. Any detection would be non-specific, that is, anything (smoke, dust, biological agent) causing an increase in particles of a certain size will cause the operators to conduct further tests to determine if a biological warfare agent is causing the indication.

- Sample. After a non-specific indication of a possible BW attack, the detector team collects samples using the liquid sampler and the biological sampler. These samplers collect aerosol particles into a liquid suspension for subsequent analysis

- Detect. Generic detection devices determine if the particles are biological material with parameters that could indicate biological warfare agents. A "positive" indication by either of these devices leads to further tests. However, based on the potential threat, a positive indication on the non-specific particle counter may warrant initiation of agent identification protocols.

- Identify. Complementary systems are used to determine if the sampled aerosols are BW agents. Antigen-antibody reaction devices that provide visual readouts to indicate if a specific agent is present provide presumptive identification. Definitive identification of suspected BW agents occurs after a qualified laboratory analyzes an evacuated sample. Until technologies improve, our biological detection systems are only capable of presumptive identification based an antigen-antibody reactions. Throughout the remainder of this manual, "identification" with regards to biological agents means presumptive identification.

- Report. Individual systems are employed over extended distances in the battlespace. They have VHF and HF radios to provide reports when they get positive responses from the detection suite. Considerations must be given to a number of factors other than detector response before a biological agent attack determination can be made. Experts analyze these biological sensor outputs and then work this data with the staff to determine if a biological warfare attack has actually occurred. Normally, this is a corps or a higher level headquarters.

- Evacuate. Samples are taken when indicated by detector response or on order. Samples are collected, packaged, sealed and documented. A complete history of the circumstances about each sample's acquisition is provided. BDT members are highly trained in sample collection and documentation of the critical information. The samples are stored on board the BIDS vehicle in coolers provided for that purpose. BDT members evacuate the samples to pre-selected sample transfer points. A legal chain of custody is maintained throughout the transfer process. Sampling and evacuation procedures are discussed in detail in Appendix .

NBC MONITORING

SECTION III – NBC MONITORING AND SURVEYS

3-10. Every unit equipped with etectors is responsible for reporting any NBC event within its area. Monitoring is done in conjunction with unit operations and is not an additional mission which competes with operational requirements. Monitoring is done routinely to determine if a hazard is still present. Monitoring can be done on personnel, equipment, or terrain. Monitoring information enables the commander to determine the portective posture of the unit; and enables the commander to detemine if it is necessary to move to an area where the hazard is less.

- Chemical Monitoring. Chemical monitoring is done with the M256A1 Kit, the ICAM, and the ACADA.. Generally, chemical monitoring tells the commander if he can reduce the MOPP level of his unit.
- Radiological Monitoring. Radiological monitoring is done to determine the presence and intensity of the residual radition hazard. There are two types of radiological monitoring, periodic and continuous.
  - Periodic Monitoring. Periodic Monitoring consists of frequent checks of the unit area for radiation. This assures the commander that the area is not contaminated and provides a warning if contamination does arrive. Periodic monitoring is initiated under the following circumstances:
    - After the first use of nuclear weapons in a theater.
    - When a unit is out of contact with higher HQ.
    - When ordered by higher HQ.
    - When radiation readings drop below the level requiring continuous monitoring.
  - Continuous Monitoring. Continuous Monitoring is surveillance for radiation in the unit area. Frequency of readings is dependent on the units situation and the unit SOP. Continuous monitoring is initiated under the following circumstances:
    - When a nuclear detonation is observed, heard, or reported in the area of operations.
    - When an NBC 3 Report is received and the unit is in the predicted area of contamination.
    - When a dose rate of 1 cGy per hour is recorded during periodic monitoring. **NOTE:** Units return to periodic monitoring when the dose rate falls below 1 cGy per hour.
    - When ordered by the commander.

3-11. Monitoring data is recorded on DA form 1971-R, Radiological Data Sheet. All readings should be recorded on the form: however, not all readings will be reported.

- Automatic Reports. All units in a contaminated area submit certain reports automatically. These monitoring reports provide the minimum essential information for warning, hazard evaluation,and survey planning. Automatic reports include the following:
  - Initial Report. When the monitoring shows reading of 1 cGy per hour, the monitor notes the time and location and moves to shelter. The NBC defense team prepares an NBC-4 report with the word “initial” on line Romeo.
  - Peak Report. Unit monitors should take readings every 15 minutes when fallout is arriving. The dose rate will rise steadily and then begin to decrease. The monitor should record the highest dose rate and forward it to the NBC defense team. The NBC defense team then preapres the NBC-4 Report with the word “peak” on line Romeo.
- Additional reports may be requested by the NBC Center (NBCC) or by higher HQ.

NBC SURVEYS

3-12.. Surveys are missions which require the use of assets in a dedicated manner. Survey missions divert personnel and equipment from normal operations. Whenaever possible, NBC reconnaissance units should be used to perform these operations. NBC surveys are performed to obtain detailed information about a contaminated area. It is a time and resource intensive operation typically conducted in rear areas to prevent units from unknowingly entering the contaminated area. It may also be done behind the FLOT to locate and mark contaminated areas so that commanders may avoid this contamination when maneuvering and preparing forces for attack or counterattack. Critical tasks in survey include the following:

- Locate the general boundaries of the contaminated area.
- Determine the intensity of the contamination.
- Place warning markers at specified intervals around the contaminated area and at all potential entry points.
- Report all information.

3-13. Radiological Surveys present a special problem since radiation exposure must be considered in survey planning. Appendix E discusses Operational Exposure Guidance (OEG) in detail. Personnel at unit level must be familiar with radiation status categories in order to advise commanders on OEG. In addition, they must be familiar with shielding as outlined in Appendix F. These surveys may be ground or aerial and follow the procedures outlined in FM 3-19 .

3-14. The U.S. Navy uses the terms “rapid” and “detailed” surveys to describe the process of locating contamination on board vessels. Rapid surveys check only predetermined points while detailed surveys focus on locating all of the contamination within the vessel.

3-15. While each unit contributes to the NBC situational awareness within the battlespace, vast areas are still not monitored. The limited assets available to conduct reconnaissance and surveillance require that all echelons manage these assets carefully. The Comander's Guidance serves as the basis for selecting NBC NAIs for R&S missions. The use of templates, based on ATP-45, and further refinement based on available models and simulations, will help focus these efforts.

SECTION IV – NBC MARKING

3-16. Once contamination is found, it must be marked so that friendly units and personnel are able to avoid becoming contaminated. Marking a contaminated area indicates the presence of a hazard; the extent of the hazard can only be determined by a detailed survey.

3-17. Standard signs are used for marking contaminated areas. These signs are standard throughout the U.S. Army and NATO to permit easy identification. The color of the sign indicates the type of contamination. The primary or background color inicates the general type of hazard while the secondary color gives specifics as to what the hazard is. Figure 3-2 describes the various signs, their colors, and other data. Figure 3-3 shows the NBC marking kit which is available throught the supply system.

MARKING PROCEDURES

3-18. Marking signs warn friendly service members of contamination. Therefore, the signs should be place where they most likely will be encountered by friendly units. In rear areas, the entire perimenter of the hazard area may need to be marked. Adjacent signs should be within sight of each other (25 t0 100 meters apart depending on terain). This type of placement prevents units from missing the signs and entering the contaminated area. Normally reconnaissance units mark the area at the point of entry and then unit survey teams are responsible for determining and marking the extent of the contamination.

3-19. For rear areas in, around and behind the Division Support Area (DSA), and while in open terrain (i.e. desert, plains, rolling hills…etc), markers may be raised on poles for better visibility at a distance. Extra tent poles, camouflage support poles, or any other types of poles may be used. The intent is to raise the markers high enough so that they can be seen by follow-on forces or support troops from at least 200 meters away.

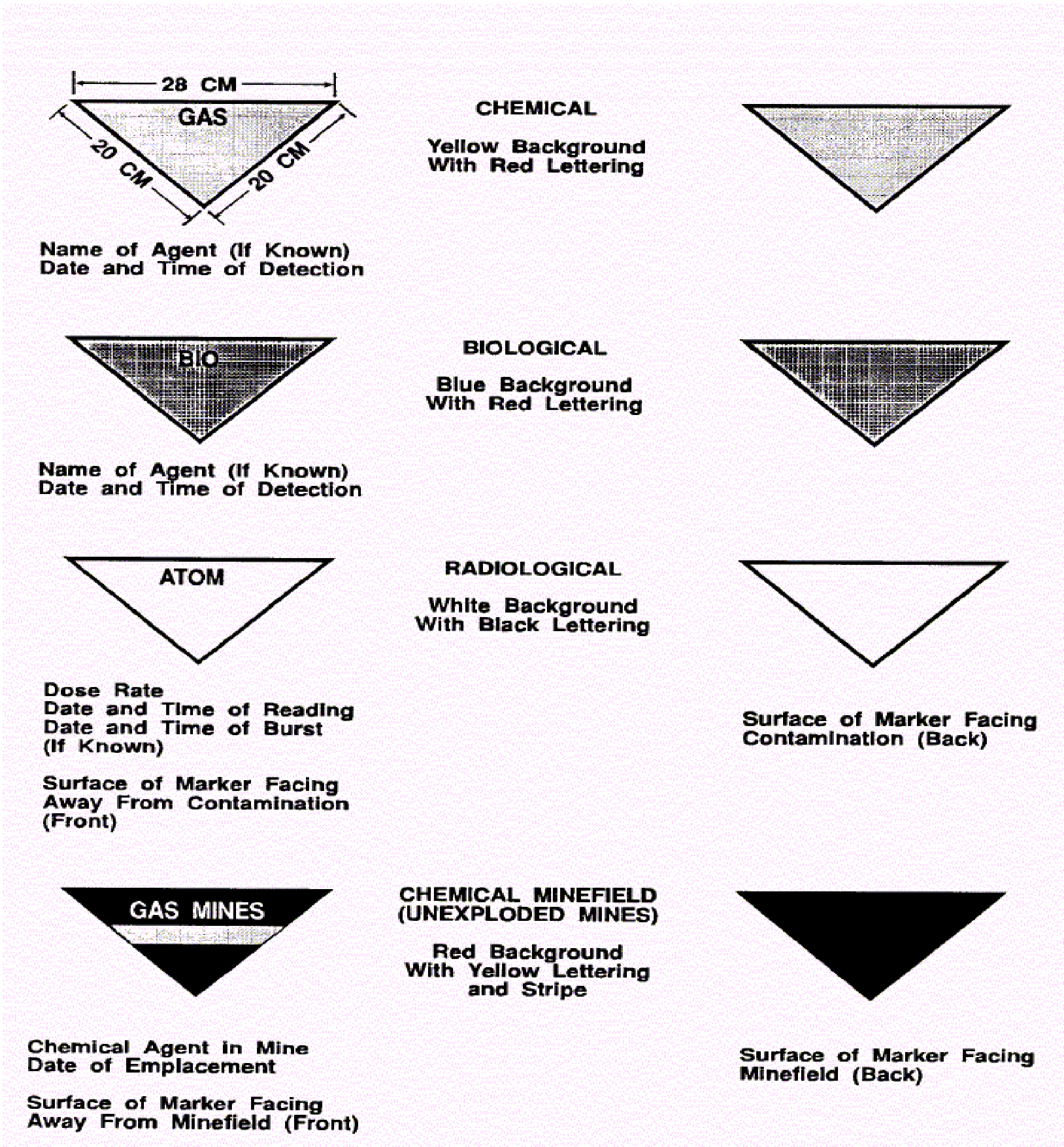


Figure 3-2. Standard Marking Signs

3-20. In addition, in rear areas, "clear areas" or "lanes" may also be marked for easy identification. One method of marking lanes is to use the CB Contamination Bypass Markers shown in Figure 3-4. *NOTE: Placing markers on poles or using bypass markers in forward areas is considered tactically unsound and should be avoided. In forward areas, this would provide a roadmap for the enemy.*

3-21. In some instances, more than one type of contamination may be present. Under these circumstances, these areas should be marked with the appropriate signs placed side by side. For example, if an area has both chemical and biological contamination, use a chemical sign and a bio sign placed close together.

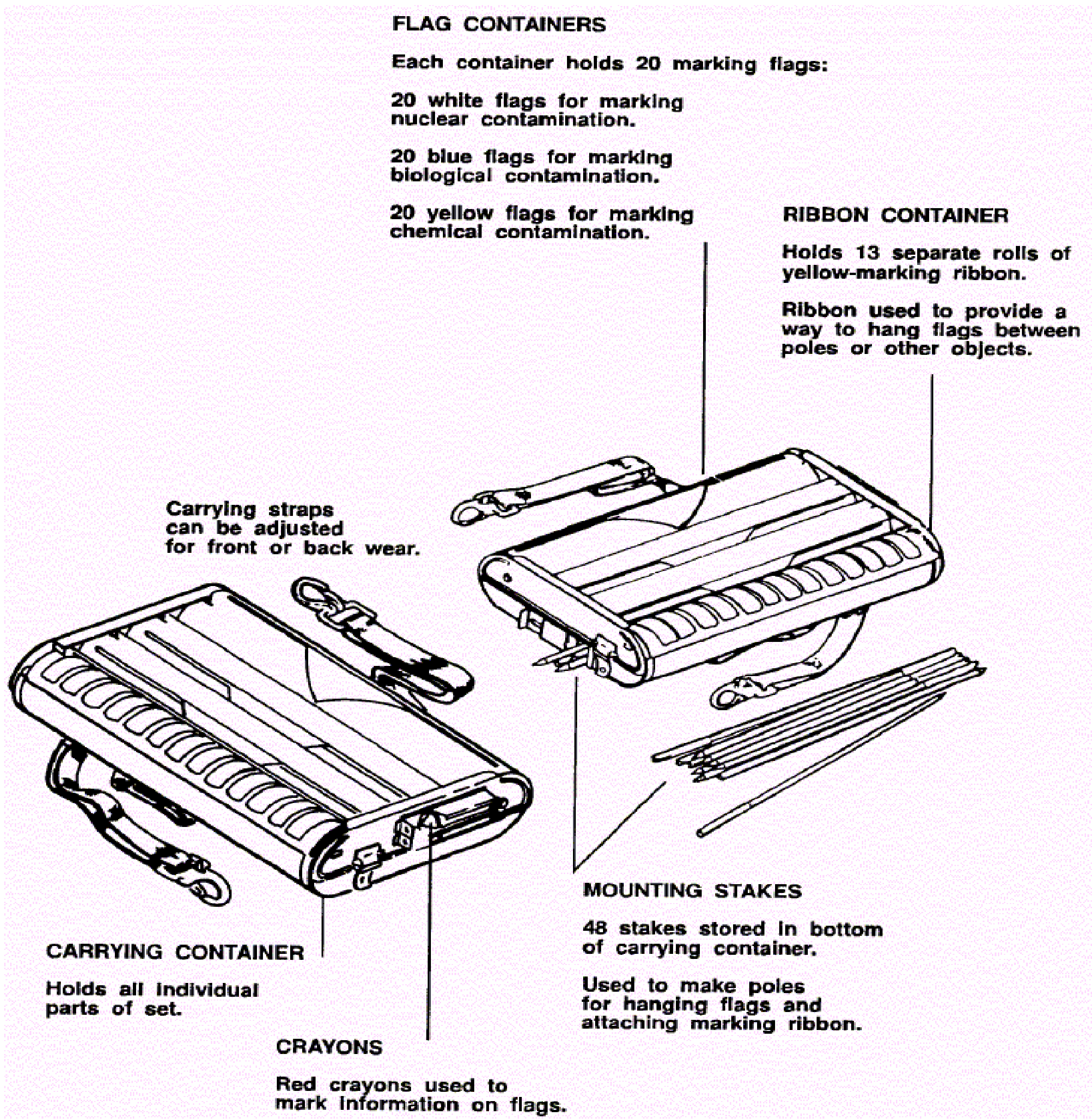


Figure 3-3 NBC Contamination Marking Kit

Would add commercial shipping symbols

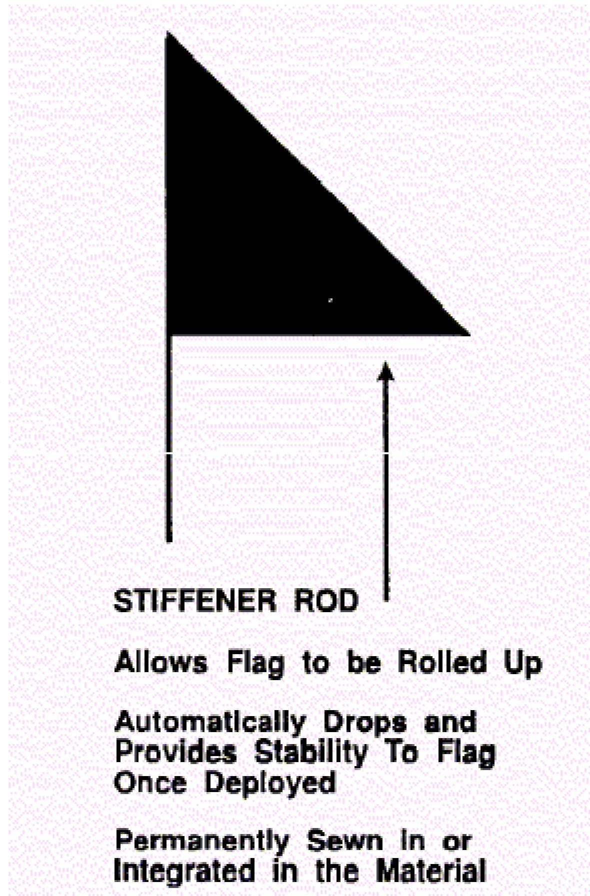


Figure 3-4 Contamination Bypass Markers

Chapter 4

Industrial Hazards

Threats from environmental hazards are not new to the military. To some extent they have always existed in the work place and other areas of operation. They may be man-made or occur naturally and may pose a health threat to personnel. Historically, military preventive medicine personnel have focused on reducing or eliminating the risks of food-, water-, waste-, insect-, and rodent-borne illnesses, occupational and environmental injuries, and heat and cold injuries. Recent deployments, however, have demonstrated the need to reduce risks from occupational and environmental exposures to toxic chemicals from industrial facilities, discarded HM, and common military chemical compounds.

FM 3-101.3

Damage or destruction of a facility, or storage site;, or transportation containers, or any act that creates the unexpected release of toxic industrial materials (TIM) into the environment will present unique challenges to U.S. and allied Armed Forces, as well as the citizens of the Host Nation (HN). Once released, these hazards may cause immediate or delayed incapacitation or death. To safeguard friendly forces and civilians from the potential hazards, peacetime and tactical chemical contamination avoidance principles must be carefully blended. Industrial chemical compounds may not be detectable by the standard chemical detection devices of tactical units. Industrial compounds may not be detectable with the human senses and may cause symptoms that are different than those symptoms from war chemicals. Prior planning is essential to minimize the effects or hazards resulting from the damage or destruction of a chemical or biological facility.

SECTION I – CHEMICAL AND BIOLOGICAL HAZARDS

4.1 Every nation in the world has some form of chemical production or storage facility. Most of these facilities are used for peacetime production of essential products such as fertilizers and plastics. In general, the following categories of chemical materials will be found in most countries:

- Agricultural Chemicals – insecticides, herbicides, fertilizers, etc.

- Industrial – Chemicals used in manufacturing processes such as plastics, cleaners, etc.
- Research – chemicals as well as biological materials used in basic and applied research.

4.2 If friendly forces are required to operate in an area where production or research facilities are located, the chemical staff should take the following actions:

- Coordinate, through the civil affairs staff, with HN emergency response teams. Such teams may be from the HN government, the HN armed forces, or from the facility itself.
- Identify the type of chemical or biological material present, the type of hazard it represents (vapor, liquid, both), and the extent of the hazard downrange.
- Determine whether standard Chemical Defense Equipment (protective mask, boots, suit, gloves) will protect against the harmful effects of the released materials.
- Coordinate with other chemical staffs for technical assistance.
- Coordinate with higher headquarters and HN to identify the availability of CAIRA (Chemical Accident/Incident Response and Assistance) teams, Technical Escort units, or other similar civilian agencies available to assist if needed.
- Develop warning systems and establish evacuation procedures for noncombatants.
- Identify a chain of command for supervision and coordination of the clean-up effort.

4-3. In the event that civilian chemical materials are released, units should immediately take the following steps:

- Notify higher, subordinate and adjacent units using the Warning and Reporting System (NBCWRS), and notify HN authorities.
- Assume Mission Oriented Protective Posture (MOPP) 4 and begin continuous monitoring with available detection equipment.
- Secure the area around the facility. Establish a security perimeter of 620-meter radius around the site. From this perimeter, draw a 10 km radius circle to indicate the potential downwind hazard zone (See Appendix D)
- Evacuate all personnel from within the 620-meter security zone. All personnel within the 10 km hazard zone should assume full chemical protection (MOPP4) or be evacuated from the area. Military teams should maintain this posture until relieved by appropriate authority.
- The perimeters of the security or hazard zone may increase or decrease after the response team(s) arrive depending on the chemical involved, the extent of the damage to the facility, and the weather conditions.

4-4. Large scale biological facilities will not be as common as chemical facilities. However, some pharmaceutical manufacturers will have large quantities of hazardous biological materials and large quantities of solvents and other chemicals.

Caution should be used around biological research facilities and hospitals that may have some quantities of pathogens.

SECTION I – RADIOLOGICAL HAZARDS

4-5. A number of nations have invested in nuclear power and nuclear weapon research is extensive and increasing. The increase in nuclear power plants and nuclear research facilities makes increasingly likely that U.S. forces will have to operate in and around areas where these types of facilities are located. Damage or sabotage at one of these facilities will present some unique challenges to U.S. and allied armed forces and the citizens of the host nation. Accidental radiological releases into the environment may cause immediate medical problems as well as problems which may not surface until years later. All plants can produce radiation hazards if the facilities are damaged. In order to safeguard friendly forces and civilians from these hazards, tactical nuclear contamination avoidance principles must be carefully blended with civilian radiological control procedures.

4-6. If a nuclear facility (power plant, research facility, etc) is damaged or destroyed, airborne radiation is of the greatest concern. Some isotopes such as Iodine 131 will escape as a gas and can be absorbed through inhalation. In addition, both alpha and beta particles may be present in the downwind plume. Although alpha radiation is not considered tactically significant, it is of prime importance in peacetime radiation safety. When inhaled or swallowed, alpha particles can cause ionization of molecules within the body and can cause considerable damage.

4-7. Alpha particles cannot be detected with tactical RADIAC instruments (AN/VDR-2, or AN/UDR-13). Alpha contamination can only be detected with the AN/PDR-77 RADIAC Set. This instrument is normally only assigned to special teams called NAIRA (nuclear accident/incident response teams). These teams have the mission to respond to any incidents where radiological material might be released into the environment.

4-8. Beta particles are also of concern when a release of radiological materials occurs. Beta particles may cause burning of the skin and also can cause internal damage if inhaled or ingested. Over the long term, beta particles can cause damage to the eyes and cause cataracts later in life.

-

4-9. If friendly forces are required to operate in an area where a nuclear facility is located, the NBC experts, surgeon, and operations staff must work together and plan for any release of material that might occur. The staff should take the following actions:

- Coordinate for assistance from emergency response teams. Such teams may be from the HN government, the HN armed forces, Allied armed forces, or from the nuclear facility itself.

- Identify the type of radiological material present, the type of hazard it represents (alpha, beta, gamma, neutron, x-ray), and the potential extent of the hazard based in the type of release.
- Determine whether standard NBC Defense Equipment (protective mask, boots, suit, gloves) will protect against the harmful effects of the released materials.
- Coordinate with other the radiological protection officer for technical assistance.
- Coordinate with higher headquarters and HN to identify the availability of NAIRA (Nuclear Accident/Incident Response and Assistance) teams, Technical Escort units, or other similar civilian agencies available to assist if needed.
- Identify evacuation sites and establish evacuation procedures for noncombatants.
- Identify a chain of command for supervision and coordination of the clean-up effort.

4-10. In the event that civilian nuclear materials are released, units in the vicinity should immediately take the following steps:

- Notify higher, subordinate and adjacent units using the NBCWRS.
- Begin continuous monitoring. Tactical units will not be able to detect alpha radiation; however, monitoring with the AN/VDR-2 with the beta shield open will provide a capability to detect beta and gamma radiation which will also be present.
- Secure the area around the facility. Establish and maintain a security perimeter of 620-meter radius around the site until relieved by proper authority.
- Attempt to evacuate all personnel from within the 620-meter security zone if it can be one without unnecessary exposure to ionizing radiation.
- Anyone operating in and around the site should wear protective masks or industrial respirators to protect themselves from inhaling or swallowing particulates. In addition, the protective mask will protect the eyes from beta particles.

- 4-11. Appendix C outlines the ATP 45 requirements for Release Other Than Attack. In addition, information on civilian types of hazards is available in FM 3-11.21, Consequence Management.

Chapter 5

NBC Warning and Reporting System (NBCWRS)

The primary means of warning units of an actual or predicted NBC hazard is the NBC Warning and Reporting system (NBCWRS). It is a key in limiting the effects of NBC attacks. The NBCWRS allows units to determine required protective measures and plan operations. Units take action depending on the mission and type of hazard present. If the mission allows, affected units alter plans to avoid the hazard. Otherwise, the units upgrade protective measures and occupy or cross the hazard area. Units use NBCWRS as battlefield intelligence.

The Joint Warning and Reporting System (JWARN) will automate many features of the NBCWRS and provide improved flow of data and information for the joint task force (JTF).

SECTION I – STANDARD NBC REPORTS

5-1. The NBCWRS consists of six reports for NBC attacks. Each is standardised by ATP 45/STANAG 2103 (Edition 8), dated Sep 2000 and the United States Message Text Format (USMTF). The U.S., and its NATO and British, Canadian, and Australian allies use the same message formats. This improves accuracy, comprehension, and interoperability of the system. It also increases the speed of dissemination and submission. The standard reports are–

- **NBC 1 Observer's** report, giving basic data.
- **NBC 2 Report** used for passing the evaluated data from collected NBC 1 reports.
- **NBC 3** Report used for immediate warning of predicted contamination and hazard areas.
- **NBC 4** Report used for reporting detection data and passing monitoring and survey results. This report is used for two cases. Case one: used if an attack is not observed, and the first indication of contamination is by detection. Case two: used to report measured contamination as a part of a survey or monitoring team.
- **NBC 5** Report used for passing information on areas of actual contamination. This report can also include areas of possible contamination, but only if actual contamination co-ordinates are also included in the report.
- **NBC 6** Report used for passing detailed information on NBC events.

5-2. The reports use standard formats to shorten the message being passed. The warning and reporting system is based on a code letter system. The meaning of each letter used to transmit an NBC message is described in GTA 3-6-3. The following paragraphs describe each report. Specific instructions for acquiring the information and sending the report are discussed later in this chapter.

5-3. In addition to reporting NBC attacks the NBCWRS is used to report Releases Other Than Attacks (ROTA). Examples of these reports follow in the description of each NBC report.

SECTION II – MEANING OF SETS USED IN ALL NBC REPORTS

5-4. Each type of NBC message is comprised of a sequence of sets and has a unique identifier. The meaning of the sets is described below. Each set contains a sequence of fields.

5-5.

5-6. List of Sets for NBC Reports

SET:	MEANING:
ALFA	STRIKE SERIAL NUMBER
BRAVO	LOCATION OF OBSERVER AND DIRECTION OF ATTACK OR EVENT
CHARLIE	DATE-TIME GROUP OF REPORT OR OBSERVATION AND END OF EVENT (ROTA ONLY)
DELTA	DATE-TIME GROUP OF ATTACK OR DETONATION AND ATTACK END
FOXTROT	LOCATION OF ATTACK OR EVENT
GENTEXT	GENERAL TEXT
GOLF	DELIVERY AND QUANTITY INFORMATION
HOTEL	TYPE OF NUCLEAR BURST
INDIA	RELEASE INFORMATION ON BIOLOGICAL/CHEMICAL AGENT ATTACKS OR ROTA EVENTS
JULIET	FLASH-TO-BANG TIME IN SECONDS
KILO	CRATER DESCRIPTION
LIMA	NUCLEAR BURST ANGULAR CLOUD WIDTH AT H+5 MINUTES
MIKE	STABILISED CLOUD MEASUREMENT AT H+10 MINUTES
MIKER	DESCRIPTION AND STATUS OF EVENT (ROTA ONLY)
NOVEMBER	ESTIMATED NUCLEAR YIELD IN KILOTONS
OSCAR	REFERENCE DATE-TIME GROUP FOR ESTIMATED CONTOUR LINES
PAPAA	PREDICTED ATTACK AND HAZARD AREA
PAPAB	DETAILED FALLOUT HAZARD PREDICTION PARAMETERS
PAPAC	RADAR DETERMINED EXTERNAL CONTOUR OF RADIOACTIVE CLOUD
PAPAD	RADAR DETERMINED DOWNWIND DIRECTION OF RADIOACTIVE CLOUD
PAPAR	PREDICTED ISOLATION AND HAZARD AREA (ROTA ONLY)
PAPAX	HAZARD AREA LOCATION FOR WEATHER PERIOD
QUEBEC	LOCATION OF READING/SAMPLE/DETECTION AND TYPE OF SAMPLE/DETECTION
ROMEO	LEVEL OF CONTAMINATION, DOSE RATE TREND & DECAY RATE TREND
SIERRA	DATE-TIME GROUP OF READING OR INITIAL DETECTION OF CONTAMINATION
TANGO	TERRAIN/TOPOGRAPHY AND VEGETATION DESCRIPTION
WHISKEY	SENSOR INFORMATION
XRAYA	ACTUAL CONTOUR INFORMATION
XRAYB	PREDICTED CONTOUR INFORMATION
YANKEE	REPRESENTATIVE DOWNWIND DIRECTION AND DOWNWIND SPEED
ZULU	ACTUAL WEATHER CONDITIONS

Table 5-1

SECTION III – CLASSIFICATION AND PRECEDENCE

5-7. Unless the NBC message contains specific operational information, e.g. effects on troops, all such messages should be unclassified.

5-8. NBC 1 messages reporting the **FIRST** enemy use of NBC weapons (first use of nuclear weapons, first use of biological weapons and first use of chemical weapons) must be given precedence FLASH (Z).

5-9. All other messages should be given a precedence, which reflects the operational value of the contents. Normally IMMEDIATE (O) would be appropriate.

5-10. Once an NBC event occurs, the number of NBC messages will be substantial. NBC staffs must prepare their SOPs carefully in order to avoid an unnecessary load on the communication systems.

Note: When a NBC 3 NUC is used for friendly strikes, the information contained in letter sets DELTA and FOXTROT will not be sent in clear language unless the time of initiating the warning message is such that no compromise of security is involved, and unless its passage in clear language is essential to troop safety. Only coding systems, which meet NATO security criteria, are to be used.

Note: Examples of NBC 1 to NBC 6 messages are given on the following pages. Users of NBC messages are not restricted to the use of sets shown in the examples. The “Cond” column in the examples shows that each set is either operationally determined (O) or mandatory (M) for each message type.

5-11. NBC reports start with a common message heading consisting of NBC report number (1-6), and event (NUC, BIO, CHEM, ROTA or unknown). Note that the sets in the BIO and CHEM messages are the same; therefore, the examples appear as BIO or CHEM.

SECTION IV - NBC 1 REPORT

5-12. The NBC 1 Report is the most widely used report. The observing unit (source) uses this report to provide NBC attack data. All units must be familiar with the NBC1 Report format and its information. The unit must prepare this report quickly and accurately and send it to the NBC SCC.

5-13. NBC SCC or NBC Collection Centre (NBCC) will decide which NBC 1 Reports to forward to the next higher headquarters. If several reports are received on the same NBC attack, then a consolidated NBC 1 Report is forwarded. This reduces the number of reports to a manageable level. If the NBC 1 report, however, is based on a chemical agent alarm going off and, there is no other indication of an attack (such as in-coming artillery rounds) the NBC SCC chemical staff should inform higher headquarters, but request that the sending unit verifies the attack with appropriate detection equipment (e.g. with two or more sampler/detector tickets from a M256 Chemical Agent Detector Kit). The attack should be verified at this level before the NBC 1 Report is sent to higher headquarters. This helps to prevent a false report from causing an entire task force to go into Mission Oriented Protective Posture (MOPP). NBC 1 reports are not routinely passed to corps or higher NBC centres (NBCC) except for the initial use report. Precedence for the NBC 1 Report depends on whether or not it is an initial report. The initial use report is FLASH precedence; all others are IMMEDIATE precedence.

5-14. Individuals identified by unit SOP submit observations to the unit NBC defence team at company/battery or troop level. They need not use the NBC 1 Report format or individual line items of the NBCWRS to pass this data to the NBC Defence Team. (This report is generally in the form of a SPOT report or SALUTE report). The unit NBC defence team normally consists of the unit chemical NCO (54B20) or an NBC NCO that has been school trained at an area NBC defence two week school, an officer and an enlisted soldier (specialist 4 or above) that has attended the same two week school. Theses soldiers will have the expertise at unit level of advising the commander on NBC defence matters and formatting NBC reports.

5-15. Normally, the unit NBC defence team formats NBC 1 Reports. This ensures the commander or his or her representative knows the content of the report. It also ensures that the report is in the proper format and is as correct as possible.

5-16. All data is sent in a single, complete NBC 1 Report. Do not divide data into two parts to create a subsequent report. NBC 1 Reports are not attack notifications; they simply pass on data. Separate procedures must be developed for attack notification and are beyond the scope of this manual. Attack notification may take the form of a SALUTE, SPOT, or SITREP Report and should be addressed in detail in unit SOPs.

INITIAL USE REPORT

5-17. The first time an NBC weapon is used against US forces the designated unit will send the NBC 1 Report with al FLASH precedence. Each intermediate headquarters will forward the report with a FLASH precedence (or IMMEDIATE precedence if a previous NBC 1 Report has been forwarded). If the report is for a second attack within the division, use IMMEDIATE.

5-18. The observer determines the date-time group of the attack, location of the attack, means of delivery, type of burst (air or ground), and if possible, type of agent for CB attacks. For nuclear attacks the observer also determines the flash-to-bang time, illumination time, location of (GZ) ground zero or azimuth to attack, and stabilized nuclear cloud measurements. Specialized equipment is used to determine stabilized cloud measurements and require a qualified operator (other steps specific to a nuclear burst will be discussed at the end of this section). The NBC defence team then formats the NBC 1 Report and forwards it to the next higher headquarters. All units prepare and forward NBC 1 Reports.

5-19. NBC SCC and higher headquarters screen NBC 1 Reports and decide which report(s) to forward. If the headquarters receives several reports pertaining to the same attack, it forwards a consolidated NBC 1 Report instead of separate reports.

5-20. Nuclear attacks require additional information to be gathered with specialized equipment therefore specific units have been designated as observer units. Personnel qualified to operate this equipment gather data, such as azimuth to the attack from the observer, observer location, and cloud width at H + 5 minutes, or cloud top/bottom angle at H + 10 minutes. Aerial observers report cloud top/bottom height at H + 10 minutes. If such equipment is not available to the unit, use the lensatic compass to take measurements as accurately as possible. If the unit is a designated observer unit, it may submit a subsequent NBC 1 nuclear report if new data concerning actual GZ location or the presence or absence of a crater is obtained. Nondesignated observer units should not submit subsequent reports unless requested. By choosing designated observer units, the NBCC can limit the number of reports and ensure the accuracy of the reports received.

5-21. Electromagnetic pulse (EMP), transient radiation effects on electronics (TREE), blackout, and an active enemy electronic warfare threat will also take their toll on our communication systems. NBC 1 reports will have to complete with urgent requests for status and damage information from the affected and nearby areas.

5-22. The first time an NBC weapon is used against US forces the designated unit will send the NBC 1 Report with a FLASH precedence. Each intermediate headquarters will forward the report with a FLASH precedence (or IMMEDIATE precedence if a previous NBC 1 Report has been forwarded). If the report is for a second attack within the division, use IMMEDIATE.

5-23. The observer determines the date-time group of the attack, location of the attack, means of delivery, type of burst (air or ground), and if possible, type of agent for CB attacks. For nuclear attacks the observer also determines the flash-to-bang time, illumination time, location of (GZ) ground zero or azimuth to attack, and stabilized nuclear cloud measurements. Specialized equipment is used to determine stabilized cloud measurements and require a qualified operator (other steps specific to a nuclear burst will be discussed at the end of this section). The NBC defence team then formats the NBC 1 Report and forwards it to the next higher headquarters. All units prepare and forward NBC 1 Reports.

5-24. SCNBCC and higher headquarters screen NBC 1 Reports and decide which report(s) to forward. If the headquarters receives several reports pertaining to the same attack, it forwards a consolidated NBC 1 Report instead of separate reports.

5-25. Nuclear attacks require additional information to be gathered with specialized equipment therefore specific units have been designated at observer units. Personnel qualified to operate this equipment gather data, such as azimuth to the attack from the observer, observer location, and cloud width at H + 5 minutes, or cloud top/bottom angle at H + 10 minutes. Aerial observers report cloud top/bottom height at H + 10 minutes. If such equipment is not available to the unit, use the lensatic compass to take measurements as accurately as possible. If the unit is a designated observer unit, it may submit a subsequent NBC 1 nuclear report if new data concerning actual GZ location or the presence or absence of a crater is obtained. Nondesignated observer units should not submit subsequent reports unless requested. By choosing designated observer units, the NBCC can limit the number of reports and ensure the accuracy of the reports received.

5-26. Electromagnetic pulse (EMP), transient radiation effects on electronics (TREE), blackout, and an active enemy electronic warfare threat will also take their toll on our communication systems. NBC 1 reports will have to complete with urgent requests for status and damage information from the affected and nearby areas.

NBC 1

Purpose: Observer's report, giving basic data

Set	Description	NUC Cond	Example
ALFA	Strike Serial Number	O	
BRAVO	Location of Observer and Direction of Attack or Event	M	BRAVO/32UNB062634/2500MLG//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997//
FOXTROT	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	M	GOLF/SUS/AIR/1/BOM/1//
HOTEL	Type of Nuclear Burst	M	HOTEL/SURF//
JULIET	Flash-to-Bang Time in seconds	O	JULIET/57//
LIMA	Angular Cloud Width	O	LIMA/18DGT//
MIKE	Stabilized Cloud Measurement at H+10 Minutes	O	MIKE/TOP/33DGT/9KM//
PAPAC	Radar Determined External Contour of Radioactive Cloud	O	
PAPAD	Radar Determined Downwind Direction of Radioactive Cloud	O	
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	CHEM Cond	Example
ALFA	Strike Serial Number	O	
BRAVO	Location of Observer and Direction of	M	BRAVO/32UNB062634/2500MLG//

	Attack or Event		
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
FOXTROT	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	M	GOLF/OBS/AIR/1/BML/-//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERVE/P/VAP//
TANGO	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	ROTA Cond	Example
ALFA	Strike Serial Number	O	
BRAVO	Location of Observer and Direction of Attack or Event	M	BRAVO/32UNB062634/2500MLG//
CHARLIE	Date-Time-Group of Report or Observation and End of Event	M	CHARLIE/281530ZSEP1997//
FOXTROT	Location of Attack or Event	O	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	M	GOLF/SUS/TRK/1/TNK/SML//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/GAMMA//
MIKER	Description and Status	O	MIKER/LEAK/CONT//
TANGO	Terrain/Topography and Vegetation Description	M	TANGO/URBAN/URBAN//
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

SECTION V - NBC 2 REPORT

5-27. The NBC 2 Report is based on one or more NBC 1 Reports. It is used to pass evaluated data to higher, subordinate, and adjacent units. Division NBCC is usually the lowest level that prepares NBC 2 Reports. NBC SCC personnel may prepare the NBC 2 Report if they have sufficient data. However, these units will not assign a strike serial number. Units use the NBC 2 as a factor in determining whether to adjust MOPP levels, and to assist in planning future operations.

5-28. Use other line items if the information is known. Subsequent data may be received after an NBC 2 Nuclear report is sent. If this data changes the yield or GZ location, send this data in an NBC 2 update report.

NBC 2

Purpose: Report used for passing evaluated data.

Set	Description	NUC Cond	Example
ALFA	Strike Serial Number	M	ALFA/UK/A234/001/N/55//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997//
FOXTROT	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	M	GOLF/SUS/AIR/1/BOM/1//
HOTEL	Type of Nuclear Burst	M	HOTEL/SURF//
NOVEMBER	Estimated Nuclear Yield in KT	M	NOVEMBER/UNK//
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	BIO Cond	Example
ALFA	Strike Serial Number	M	ALFA/UK/A234/001/B//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
FOXTROT	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	M	GOLF/OBS/AIR/1/BML/-//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/BIO/-/DET//
TANGO	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	ROTA Cond	Example
ALFA	Strike Serial Number	M	ALFA/US/WEP/001/RN//
CHARLIE	Date-Time-Group of Report /Observation and Event End	M	CHARLIE/281530ZSEP1997/ 281545ZSEP1997//
FOXTROT	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	M	GOLF/SUS/TRK/1/TNK/1//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/GAMMA//
MIKER	Description and Status	M	MIKER/LEAK/CONT//
TANGO	Terrain/Topography and Vegetation Description	M	TANGO/URBAN/URBAN//
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

SECTION VI - NBC 3 REPORT

5-29. Division NBCC uses the NBC 2 Reports and the current wind information to predict the downwind hazard area. This is sent as an NBC 3 Report. It is sent to all units that could be affected by the hazard. Each unit plots the NBC 3 Report and determines which of its subordinate units are affected and warns those units accordingly.

5-30. The NBC 3 Report is a prediction of a downwind hazard area. This prediction is safe-sided to ensure that a militarily significant hazard will not exist outside of the predicted hazard area.

5-31. Units within the downwind hazard area must adjust their MOPP level, if necessary. They must ensure that chemical agent alarms are placed far enough upwind to provide adequate warning. The NBC 3 Chemical Report is re-evaluated every two hours. The hazard prediction could change significantly. Units currently affected and those previously affected must be notified that they are in (or no longer in) the hazard area.

5-32. The NBC 3 report is also used as a prediction of the fallout areas from a nuclear attack. This prediction is safe-sided to ensure that a militarily significant hazard will not exist outside of the predicted hazard area. In other words, Zone I will represent areas where the dose rate will exceed 150 centigray per hour (cGyph) within 4 hours; and Zone II is no more than 50 cGyph in 4 hours and less than 150 cGyph in 24 hours.

5-33. Commanders should use this report as battlefield intelligence when planning missions.

5-34. When a unit is in a downwind hazard/ fallout area, the commander must decide whether to stay or move. This decision is based on the mission, and higher headquarters guidance.

5-35. A unit may use a transport and dispersion model to determine predicted levels of chemical hazards contours of LCt50, ICt50, ICt5, and miosis. These contours will be annotated in the XRAYB lines of the NBC 3 report. The unit running the model must be able to accurately input data into the parameters of attack location, total mass released, wind direction, wind speed, and atmospheric stability. Modelling should only be used for hazard prediction of an observed attack.

5-36. Attack location must be able to be confirmed within 500 meters of actual attack. A detection of a hazard is not an appropriate method of determining attack location. The attack must be observed or visually with radar.

5-37. Total mass released must be able to be determined within ½ to two times of the actual mass released. Mass released is the parameter that will change based on the type of operation being conducted, the significance of what the enemy is attacking, munitions or delivery systems that the enemy may use, and the enemy's ability to mass fires into a targeted area. If the operator can not determine the mass released then the operator must use the highest probable weapon system and agent fill.

5-38. Accuracy in wind direction, wind speed, and atmospheric stability requires better weather data than what is provided in the CDM. If a unit has the ability to get higher resolution weather data (ie. gridded weather data) then the unit should have adequate weather data in order to develop modelled hazard contours.

NBC 3

Purpose: Report used for passing immediate warning of predicted contamination and hazard areas

Set	Description	NUC Cond	Example
ALFA	Strike Serial Number	M	ALFA/UK/A234/001/N/45//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997//
FOXTROT	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//

GOLF	Delivery and Quantity Information	O	GOLF/SUS/AIR/1/BOM/4//
HOTEL	Type of Nuclear Burst	O	HOTEL/SURF//
NOVEMBER	Estimated Nuclear Yield in KT	O	NOVEMBER/50//
PAPAB	Detailed Fallout Hazard Prediction Parameters	M	PAPAB/019KPH/33KM/5KM/ 272DGT/312DGT//
PAPAC	Radar Determined External Contour of Radioactive Cloud	O	PAPAC/32VNJ456280/32VNJ456119/32VNJ556182/32VNJ576200/ 32VNJ566217/32VNJ456280//
PAPAD	Radar Determined Downwind Direction of Radioactive Cloud	O	PAPAD/030DGT//
XRAYB*	Predicted Contour Information	O	
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

1

Set	Description	CHEM Cond	Example
ALFA	Strike Serial Number	M	ALFA/UK/A234/001/C//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	M	DELTA/201405ZSEP1997/ 201420ZSEP1997//
FOXTROT	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	O	GOLF/OBS/AIR/1/BML/-//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERVE/P/VAP//
PAPAA	Predicted Attack and Hazard Area	M	PAPAA/10KM/3-10DAY/25KM/ 2-6DAY//
PAPAX	Hazard Area Location for Weather Period	M	PAPAX/081200ZSEP1997/ 32VNJ456280/32VNJ456119/ 32VNJ576200/32VNJ566217/ 32VNJ456280//
XRAYB*	Modelled Hazard Contour Information	O	XRAYB/ICt50/32VNJ456280/32VNJ446270/32VNJ456260/32VNJ466260/32VNJ476270/ 32VNJ466280
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	GENTEXT/NBCINFO/RECALCULATION BASED ON WEATHER CHANGE//

2

Set	Description	ROTA Cond	Example
ALFA	Strike Serial Number	M	ALFA/US/WEP/001/RN//
CHARLIE	Date-Time-Group of Report /Observation and Event End	M	CHARLIE/281530ZSEP1997//
FOXTROT	Location of Attack or Event	M	FOXTROT/32UNB058640/EE//
GOLF	Delivery and Quantity Information	O	GOLF/SUS/TRK/17TNK/1//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/SURF/2978/-/GAMMA//
PAPAR	Predicted Isolation and Hazard Area	M	PAPAR/1000M/5KM//
PAPAX	Hazard Area Location for Weather	M	PAPAX/081200ZSEP1997/

	Period		32VNJ456280/32VNJ456119/ 32VNJ576200/32VNJ566217/ 32VNJ456280//
XRAYB*	Predicted Contour Information	O	
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

*Set is repeatable up to 50 times to represent multiple contours for

SECTION VII - NBC 4 REPORT

5-39. Actual contamination is reported using an NBC 4 Report. Separate NBC 4 Reports are plotted on the tactical map to show where the hazard exists. If monitoring information is incomplete, a survey may be directed. From this data a contamination overlay is created.

5-40. A contamination overlay is sent to all units by computer data base update, electrical facsimile, messenger, liaison officer, and the NBC 5 Report.

NBC 4

Purpose: Report used for reporting detection data and passing monitoring and survey results

Set	Description	NUC Cond	Example
ALFA	Strike Serial Number	O	ALFA/UK/A234/001/N/50//
KILO	Crater Description	O	KILO/UNK//
QUEBEC*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/GAMMA/-//
ROMEO*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	M	ROMEO/7CGH/DECR/DN//
SIERRA*	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
WHISKEY	Sensor Information	O	WHISKEY/POS/POS/YES/HIGH//
YANKEE*	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU*	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	CHEM Cond	Example
ALFA	Strike Serial Number	O	ALFA/UK/A234/001/C//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/UNK/NERVE//
QUEBEC*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/-/DET//
ROMEO*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	ROMEO/20PPM//
SIERRA*	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
TANGO*	Terrain/Topography and Vegetation Description	M	TANGO/FLAT/URBAN//

WHISKEY	Sensor Information	O	WHISKEY/POS/POS/NO/MED//
YANKEE*	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU*	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	ROTA Cond	Example
ALFA	Strike Serial Number	O	ALFA/US/WEP/001/RN//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/SURF/2978/-/GAMMA//
QUEBEC*	Location of Reading/Sample/Detection and Type of Sample/Detection	M	QUEBEC/32VNJ481203/GAMMA/-//
ROMEO*	Level of Contamination, Dose Rate Trend and Decay Rate Trend	O	ROMEO/7CGH/DECR/DF//
SIERRA*	Date-Time-Group of Reading or Initial Detection of Contamination	M	SIERRA/202300ZSEP1997//
TANGO*	Terrain/Topography and Vegetation Description	M	TANGO/URBAN/URBAN//
WHISKEY	Sensor Information	O	WHISKEY/-/POS/NO/HIGH//
YANKEE*	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU*	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

* Sets are repeatable up to 20 times in order to describe multiple detection, monitoring or survey points.

SECTION VIII - NBC 5 REPORT

5-41. The NBC 5 Report is prepared from the contamination plot. This report is last in order because it consists of a series of grid coordinates. Often this message must be sent on FM radio nets. This requires lengthy transmission. The recipient is required to plot each co-ordinate and redraw the plot. Complete details can follow later on the facsimile or messenger-delivered plot.

5-42. With the exception of line item Alfa, when a user has previously received data through other NBC reports, the data need not be repeated on the NBC 5.

5-43. This message may be sent before or after a contamination plot has been received. The NBC 5 Report is also used to report the closure of a decontamination site. The NBC 5 Report should include co-ordinates for the site and sump so as to notify other units of the contamination area.

5-44. For most avoidance situations, only the outer boundary of the area is necessary. Complete details can follow later on the facsimile or messenger-delivered plot. Some contamination situations cannot be reported through use of the NBC 5. These are areas of neutron-induced contamination. These areas must be reported via the overlay.

5-45. With the exception of line item Alfa, when a user has previously received data through other NBC reports, the data need not be repeated on the NBC 5.

5-46. For example, a unit receives an NBC 3 the showing GZ location (line item Foxtrot). The GZ does not have to be reported on the NBC 5.

5-47. The NBC 5 nuclear report is also used to transmit the decay rate of fallout to field units. All units assume decay rate of fallout to be n=1.2 until informed otherwise. The NBCC determines the decay rate and sends a report such as the one below:

NBC5 NUCLEAR

A 52N002

R 1.6

5-48. This message may be sent before or after al contamination plot has been received. Since decay rate of fallout will decrease with time, the report could be sent several times during the period of interest for a contaminated area. The NBC 5 report should include co-ordinates for the site and sump, so as to notify other units of the contamination area.

NBC 5

Purpose: Report used for passing information on areas of actual contamination.

Set	Description	**NUC** Cond	Example
ALFA	Strike Serial Number	O	ALFA/UK/A234/001/N/38//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
OSCAR	Reference Date-Time-Group for Estimated Contour Lines	M	OSCAR/201505ZSEP1997//
XRAYA*	Actual Contour Information	M	XRAYA/5CGH/32UND620475/ 32UND662522/32UND883583/ 32UND830422/32UND620475//
XRAYB*	Predicted Contour Information	O	XRAYB/75/100CGH/32UND621476/ 32UND621477/32UND622477/ 32UND622476/32UND621476//
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

Set	Description	CHEM Cond	Example
ALFA	Strike Serial Number	O	ALFA/UK/A234/001/C//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	M	INDIA/AIR/NERVE/P/VAP//
OSCAR	Reference Date-Time-Group for Estimated Contour Lines	M	OSCAR/201505ZSEP1997//
XRAYA*	Actual Contour Information	M	XRAYA/LCT50/32VNJ575203/ 32VNJ572211/32VNJ560219/ 32VNJ534218/32VNJ575203//
XRAYB*	Predicted Contour Information	O	
YANKEE	Downwind Direction and Speed	O	YANKEE/270DGT/015KPH//
ZULU	Actual Weather Conditions	O	ZULU/4/10C/7/5/1//
GENTEXT	General Text	O	

SECTION IX - NBC 6 REPORT

5-49. This report summarizes information concerning a chemical or biological attack(s) and is prepared at NBC SCC level, but only if requested by higher headquarters. It is used as an intelligence tool to help determine enemy future intentions. The NBC 6 Report is submitted to higher headquarters. It is written in narrative form, with as much detail as possible under each line item.

NBC 6

Purpose: Report used for passing detailed information on nuclear, biological, chemical, or ROTA events.

Set	Description	NUC Con	Example
ALFA	Strike Serial Number	O	ALFA/UK/A234/001/N//
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997//
FOXTROT	Location of Attack and Qualifier	O	FOXTROT/32UNB058640/EE//
QUEBEC	Location & Type Reading /Sample /Detection	O	QUEBEC/32VNJ481203/GAMMA/-//
SIERRA	Date-Time-Group of Reading	O	SIERRA/202300ZSEP1997//
GENTEXT	General Text	M	GENTEXT/NBCINFO/WEAPON YIELD ESTIMATED FOR EVALUATION OF COLLATERAL DAMAGE PURPOSES ONLY//

Set	Description	Chem Cond	Example
ALFA	Strike Serial Number	O	**ALFA/UK/A234/001/C//**
DELTA	Date-Time-Group of Attack or Detonation and Attack End	O	DELTA/201405ZSEP1997/ 201420ZSEP1997//
FOXTROT	Location of Attack and Qualifier	O	FOXTROT/32UNB058640/EE//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/AIR/NERVE/P/VAP//
QUEBEC	Location & Type Reading /Sample /Detection	O	QUEBEC/32VNJ481203/-/DET//
SIERRA	Date-Time-Group of Reading	O	SIERRA/202300ZSEP1997//
GENTEXT	General Text	M	GENTEXT/NBCINFO/SICA LAB REPORT HAS IDENTIFIED THE AGENT AS VX//

Set	Description	**ROTA** Cond	Example
ALFA	Strike Serial Number	O	ALFA/US/WEP/001/RN//
CHARLIE	Date-Time-Group of Report /Observation and Event End	O	CHARLIE/281530ZSEP1997/ 281545ZSEP1997//
FOXTROT	Date-Time-Group of Report /Observation and Event End	O	FOXTROT/32UNB058640/EE//
INDIA	Release Information on Biological/Chemical Agent Attacks or ROTA events	O	INDIA/SURF/2978/-/GAMMA/-//
QUEBEC	Location & Type Reading /Sample	O	QUEBEC/32VNJ481203/GAMMA//

	/Detection		
SIERRA	Date-Time-Group of Reading	O	SIERRA/202300ZSEP1997//
GENTEXT	General Text	M	GENTEXT/NBCINFO/HOSPITAL VEHICLE CARRYING RADIOACTIVE WASTE OVERTURNED ON ROUTE 25//

SECTION X - MERWARN MESSAGES

5-50. A simplified fallout warning system is established for broadcasting, via MERCOMMS or coastal radio stations, warnings of fallout endangering merchant shipping, - the MERWARN SYSTEM.

5-51. The MERWARN system calls for the origination, by naval authorities, of the following five types of messages:

5-52. **MERWARN NBC EDM**. A message containing information on downwind speed and **downwind direction** for a 1 megaton (1000 KT) nuclear detonation. It will give the master of a ship, observing a nuclear explosion, an immediate indication of the area likely to be affected by fallout.

5-53. **MERWARN NBC 3 NUC**. A message used for passing immediate warning of expected radiological contamination.

5-54. **MERWARN NBC Chemical Downwind Message (MERWARN NBC CDM)**. A message which will allow merchant ships' masters to plot the predicted hazard area following a chemical attack.

5-55. **MERWARN NBC 3 CHEM**. A message used to promulgate the hazard resulting from a particular chemical attack.

5-56. **MERWARN DIVERSION ORDER**. A message, which gives evasive routing instructions of a more general nature, to merchant ships proceeding independently.

5-57. The following are detailed descriptions and example formats for the MERCWARN NBC messages:

5-58. **MERWARN NBC EDM**. MERWARN NBC EDM is a prediction, for a specified sea area and time interval, of the fallout, which will result from a one-megaton (1 MT) nuclear surface explosion. It will give the master of a ship, observing a nuclear explosion, an immediate indication of the area likely to be affected by fallout.

5-59. MERWARN NBC EDM will be issued at 12-hour intervals from the time of activation of the MERCOMMS system, and will be valid 12 hours ahead from the date and time given in the first line of the message (A). In the event of changing meteorological conditions it may be necessary for the originating authorities to issue MERWARN NBC EDM more frequently. The original MERWARN NBC EDM will automatically be overruled by the latest MERWARN EDM issued.

5-60. The following standard format will be used:

- **A. Message identifier (MERWARN NBC EDM) and date-time-group (GMT) from which valid for 12 hours ahead.**
- **B. Specified sea area for which valid.**
- **C. Effective downwind direction (degrees, 3 digits) and effective downwind speed (knots, 3 digits).**
- **D. Downwind distance of Zone I (nautical miles, 3 digits).**
- **E. Additional information.**

5-61. Example:

A. MERWARN NBC EDM 180600ZSEP1999
B. Baltic Sea west of 15° 00'E
C. 045 - 020
D. 078
E. NIL.

Note: Sets B., C. and D. may be repeated for different sea areas should this be considered necessary.

5-62. MERWARN NBC 3 NUC will be issued after a nuclear attack producing fallout, and gives fallout data for a specific explosion or series of explosions, which will be identified in the message.

5-63. MERWARN NBC 3 NUC messages are issued as soon as possible after the attack, and at six hour intervals (to the nearest hour) thereafter, for as long as the fallout danger exists. They contain information, which enables the master of a ship to plot the danger area.

5-64. The standard format of MERWARN NBC 3 NUC contains the sets ALFA, DELTA, FOXTROT and PAPAB of the military NBC 3 NUC message.

5-65. The MERWARN NBC 3 NUC has the following structure:

MERWARN NBC 3 NUC

ALFA: **Strike Serial Number (as defined by the naval authority)**
DELTA: **Date-time Group of detonation (GMT)**
FOXTROT: **Location of attack (latitude and longitude, or geographical place name) and qualifier (2 digits).**
PAPAB: **Effective wind speed (3 digits and unit of measurement), downwind distance of Zone I (3 digits and unit of measurement), cloud radius (2 digits and unit of measurement),**
left and right radial line of the predicted fallout hazard area (3 digits and unit of measurement each).

5-66. Example:

MERWARN NBC 3 NUC

ALFA/UK/NBCC/02-001/N//
DELTA/021405ZSEP1999//
FOXTROT/451230N014312E/AA//
PAPAB/012KTS/028NM/02NM/272DGT/312DGT//

5-67. The MERWARN NBC 3 NUC standard format may not be suitable after a multiple nuclear attack which produces fallout from several bursts in a large or complex target area. In such cases warnings will be plain language statements of a more general nature, indicating area affected and expected movement of the fallout.

5-68. Example 1:

MERWARN NBC 3 NUC

ALFA/UK/02-001/N//
DELTA/021405ZSEP1999//
Fallout extends from Glasgow area to eastern Ireland at 021405Z and is spreading westwards with 12 Knots. Irish Sea is likely to be affected within an area of 60 nautical miles of the British coast.

5-69. Example 2:

MERWARN NBC 3 NUC

ALFA/IT/15-001/N//
DELTA/150630ZFEB1999//
Fallout is estimated to be occurring at 150830Z over Adriatic Sea east of the coast line Bari/Brindisi up to a distance of 30 nautical miles. Fallout is moving southeastwards with 016 Knots, getting weaker. It is not expected to be dangerous after 151000Z.

5-70. The MERWARN NBC CDM message contains information needed for CHEM/BIO hazard prediction by the master of a merchant ship. The MERWARN NBC CDM will be issued as required via the MERCOMMS and will be valid as specified. In the event of changes in the meteorological conditions, the MERWARN NBC CDM will be updated as required.

5-71. The following standard format will be used:

ALFA:	**Message identifier (MERWARN NBC CDM), date/time group (GMT) from which valid 6 hours ahead.**
BRAVO:	**Specified sea area for which valid.**
CHARLIE:	**Representative downwind direction (degrees, 3 digits) and representative downwind speed (knots, 3 digits).**
DELTA:	**Maximum downwind hazard distance (nautical miles, 3 digits).**
ECHO:	**Additional information.**

5-72. Example:

ALFA	**MERWARN NBC CDM 180600ZSEP1999//**
BRAVO	**BALTIC SEA WEST OF 15°00'E//**
CHARLIE	**045/020//**
DELTA	**010//**
ECHO	**NIL//**

5-73. MERWARN NBC 3 CHEM. This message is issued to pass immediate warning of a predicted chemical contamination and hazard area. MERWARN NBC 3 CHEM reports are issued as soon as possible after each attack. They contain sufficient information to enable the master of a ship to plot the downwind hazard area.

5-74. The following standard format will be used for MERWARN NBC 3 CHEM:

MERWARN NBC 3 CHEM (Message identifier)

ALFA: Strike serial number (as defined by naval authority).
DELTA: Date/time group (Z) of start and end of attack.
FOXTROT: Location of event.
GOLF: Delivery Means.
INDIA: Release Information.
PAPAA: Predicted attack and hazard area.

Note: If representative downwind speed is 5 knots or less, or variable, this letter item will consist of three (3) digits instead of co-ordinates, representing the radius of a circle in nautical miles centred on the location of the attack contained in set FOXTROT.

YANKEE: The representative downwind direction and speed.
ZULU: Information on actual weather conditions.
GENTEXT: Remarks

Note: Some of the letter items above may not be completed in the report that is received, but there will be sufficient information for a Downwind Hazard plot to be carried out.

5-75. The MERWARN NBC 3 CHEM standard format may not be suitable after a multiple chemical attack, which produces a hazard from several attacks or depositions in a large or complex target area. In such cases warnings will be plain language statements of a more general nature, indicating areas affected and expected movement of the hazard.

Example 1:

MERWARN NBC 3 CHEM

ALFA/DA/NBCCC-4/003/C//
DELTA/020300ZSEP1999//
GENTEXT/ PERSISTENT NERVE AGENT VAPOUR HAZARD EXISTS FROM NORFOLK TO HATTERAS AT 020300Z SEP 1999 AND IS SPREADING SOUTHEASTWARDS AT 017 KNOTS. SEA AREA OUT TO 100 NAUTICAL MILES FROM COAST LIKELY TO BE AFFECTED BY 020600ZSEP1999//

Example 2:

MERWARN NBC 3 CHEM

ALFA/DA/NBCC-3/003/C//
DELTA/020300ZSEP1999//
GENTEXT/PERSISTENT NERVE AGENT VAPOUR HAZARD AT 020600 SEP 99 IS ESTIMATED TO BE OCCURRING OVER MOST OF THE SEA AREAS OUT TO 40 MILES EAST OF THE COASTLINE FROM NORFOLK TO HATTERAS. HAZARD IS EXPECTED TO HAVE DISPERSED BY 021000Z SEP1999//

MERWARN DIVERSION ORDER

5-76. In addition to the origination of MERWARN NBC EDM and MERWARN NBC 3 NUC messages, naval authorities may, if circumstances dictate, broadcast general diversion orders, based upon the fallout threat, whereby merchant ships proceeding independently will be passed evasive routing instructions of a more general nature, using the standard Naval Control of Shipping (NCS) identifier MERWARN DIVERSION ORDER.

MERWARN DIVERSION ORDER

English Channel closed. All shipping in North Sea remain north of 052 degrees N until 031500ZSEP1999.

SECTION XI - MANAGING THE NBC WARNING AND REPORTING SYSTEM

5-77. Managing the NBCWRS is crucial for the success of a command. To be useful, NBC information must be collected, reported, and evaluated. Once evaluated, it can be used as battlefield intelligence. Obtaining and converting NBC information into usable NBC intelligence does not just happen. The volume of information that needs to be collected and reported could easily disrupt both communications and tactical operations if not properly managed. This section describes what information is available and how that information gets to the person or unit needing it.

COLLECTING NBC INFORMATION

5-78. The first step in managing the NBCWRS is to determine what information is available and who is available to collect it. Two types of data must be collected. Observer data provides information that an NBC attack has occurred. Monitoring, survey, and recon data provide information on where the hazard is located.

5-79. In the event of a nuclear attack all units are responsible for observing and recording but not all units will automatically report the information on a nuclear attack. Selected units with equipment to make accurate measurements submit NBC1 nuclear reports. These units are called designated observers. The division NBCC selects designated observers and lists them in the FSOP/OPORD/OPLAN.

5-80. Additional units are selected during tactical operations based on their physical locations. They are listed in the operations order. The designated observer unit is discussed later in this chapter only selected units automatically submit NBC 1 nuclear reports to the NBCC.

OBSERVER DATA

5-81. Every unit is responsible for observing and recording NBC attacks. But every unit does not automatically forward NBC 1 reports. Any unit aware of an NBC attack promptly prepares an NBC 1 Report.

MONITORING, SURVEYING AND RECONNAISSANCE DATA

5-82. NBC 1 Reports allow the NBCC to predict where the hazards will be. This prediction (NBC 3 Report) is only an estimation of the hazard area. Feedback is needed from units to determine exactly where the contamination is located.

5-83. This feedback comes from monitoring, survey and recon (NBC 4 Reports). Monitoring and recon operations give the initial location of CB hazards to the NBCC. Initial monitoring and recon reports are generally forwarded through intelligence channels to the NBCC.

5-84. Collecting NBC information is a joint effort between units and the NBCC. The unit does the actual collecting of information. The NBCC plans for and directs the collection effort. The division FSOP/OPORD/OPLAN should describe whom collects and forwards NBC information for evaluation.

EVALUATING NBC INFORMATION

5-85. The NBC data must be collected and evaluated by the NBCC and used as battlefield intelligence. Units and intermediate headquarters use the raw data to develop NBC intelligence for their own use until detailed results are available from the NBCC.

SOURCE PROCEDURES

5-86. The outer boundary of militarily significant contamination is the important information for the unit. Unit procedures for determining the location of contamination are simplified and less accurate than NBCC procedures. Emphasis is on speed rather than accuracy. Nuclear fallout predictions are estimated quickly using simplified predictions. NBC4 reports are plotted, but minimal effort is spent in analyzing the degree of contamination.

5-87. With exception of designated observer reporting units, NBC SCC consolidates and screens NBC reports to reduce the number sent to the NBCC.

NBCC PROCEDURES

5-88. Procedures used by the NBCC are more detailed and complex than those at unit level. NBC 2, NBC 3, and NBC 5 Reports from division NBCC supersede those done by subordinate units.

TRANSMITTING NBC INFORMATION

5-89. Procedures used to transmit NBC information to and from the NBCC are an important part of the NBC information system. Figure 5-1 shows the direction that various NBC reports travel. Usually the flow is through the chain of command-from source to NBC SCC to NBC Collection Center to NBC Control Center. There are exceptions to this-

- The NBCC may request data such as survey information. The unit doing the survey may report directly back to division. The monitoring unit must also send an information copy back to the parent unit for command and control (C^2) and for reordering NBC defensive equipment and supplies.
- Designated observers send reports simultaneously to the NBCC, and parent organization.
- Attached or OPCON units may have no direct contact with a parent unit. In these cases the headquarters to which they are OPCON passes NBC information.
- Units that operate independently (such as military police or engineers) will report through the headquarters controlling that area of operation.
- The method of transmitting information depends on the tactical situation and mission of the unit. Methods are specified in FSOP/OPLAN/OPORD and unit SOP. At NBC SCC and NBCC, NBC Reports usually are passed on the intelligence net rather than the command net. At SCNBCC level and lower there is generally only on FM net available. This net is required to communicate command information. Therefore, NBC Reports should be formatted ahead of time and be as short and concise as possible. In this case wire communications are best.

5-90. Each unit and command element has a specific function in an NBC environment. This function is in addition to normal combat functions. The exception to this is the NBCC whose primary function is NBC operations. The preceding pages described procedures and requirements for collecting, evaluating, and transmitting NBC information. This section describes responsibilities at each command level and is intended to be only a guide.

5-91. Source level collection, processing, and analysis techniques are designated for rapid evaluation of NBC data. The results are not as accurate as those obtained by the NBCC, but they are sufficient enough for planning until those from the NBCC can replace them. Although analysis techniques are similar for company, NBC SCC, and NBCC, each has specific responsibilities for collecting and processing NBC information. The responsibilities are listed here.

5-92. The major portion of CB information is collected and reported by company/battery/troop-level units. These units must be trained and equipped to-

- Report NBC attack data using the NBC
- Warning and Reporting System.
- Monitor for chemical agents and/or nuclear radiation.
- Plot simplified downwind hazards.
- Identify toxic chemical agents.
- Collect and forward soil and water samples.
- Conduct chemical and biological or nuclear surveys/reconnaissance.

5-93. Organization and training of personnel to perform these tasks will be in accordance with appropriate services requirements.

SUB COLLECTION CENTER (SCC) LEEL

5-94. The SCC monitors the information gathering of subordinate units. SCC chemical personnel ensure each subordinate unit is trained. SCC personnel also are trained to-

- Consolidate and forward NBC reports.
- Estimate effects of NBC hazards.
- Disseminate information on NBC activities.
- Coordinate unit NBC recon elements with and through the appropriate sections and the chemical company platoon leader tasked to support the SCNBCC.
- Coordinate with the NBC SCC or NBCC to obtain additional smoke or decon assets, if required.
- Advise the commander on how to employ CB assets.
- Plan and supervise decentralized NBC surveys.
- Maintain an NBC situation overlay.
- Coordinate with all attached NBC units.
- Coordinate with other staff sections and advise them on NBC matters.
- Plan and supervise decentralized NBC surveys.
- Collect information from and assist NBC personnel within the task force.

NBCC LEVEL

5-95. NBCC techniques involve more complicated procedures and are based upon the comparison of data from many sources. Much of this data is not available to a single unit. In addition to performing detailed analysis, the NBCC also-

- Receives, collates, evaluates, and disseminates reports of enemy NBC attacks.

- Prepares and disseminates wind messages.
- Estimates the effects of enemy biological attacks, including hazard predictions.
- Coordinates recon and survey activities with higher, lower, and adjacent units.
- Maintains an NBC situation map.
- Provides advise to G2 on NBC matters.
- Provides technical assistance to all staff levels.
- Coordinates with other staff sections and advises those staff sections on NBC matters.
- Provides technical assistance in the interrogation of POWs on NBC matters. This technical assistance is generally in the form of providing the interrogator with a list of questions to ask the prisoner. The questions may include-
  - Employment tactics
  - CB munitions
  - Types of agents available.
  - Defense training status.
- Types of defensive equipment used by
- soldiers.

DESIGNATED OBSERVER SYSTEM

5-96. Although all units have some information-gathering responsibilities, certain units, because of their capabilities and/or location, are chosen as designated observers for nuclear attacks. Designated observers must be as accurate as possible when providing data on nuclear bursts. Observers are selected to provide total coverage over the entire area of interest. This requires both ground and aerial observers. The designated observer system provides the essential data to prepare hazard location predictions and nuclear damage assessments. It provides raw observer data, using a standard report format. The NBCC specifies the primary and alternate means of communication.

Designated Ground-based Observers

5-97. Ground units are selected for the designated observer system based on the following factors-

- Battlefield location.
- Communication nets available.
- Mission (current and future) interference due to enemy action
- Training and experience.
- Anticipated reliability of data.
- Possession of organic angle-measuring equipment.

5-98. Field artillery and air defense artillery units are best suited as designated observer units. These units have organic equipment ideal for sighting measurements. See FM 101-10-1 for more information about which divisional units have the equipment. These items, in order of preference are-

- M2 aiming circle.*
- M65 or M43 battery command periscope.
- T16 or T2 thoedolite.

- M2 pocket transit

5-99. Any other unit (for example, a mortar platoon) having this or similar equipment may be designated an observer. Radar should also be considered. Many radars can define the nuclear cloud. Field artillery and air defense artillery radars are positioned in the division and corps areas.

5-100.*This equipment is preferred because it is set to grid north (GN) and measures in mils.

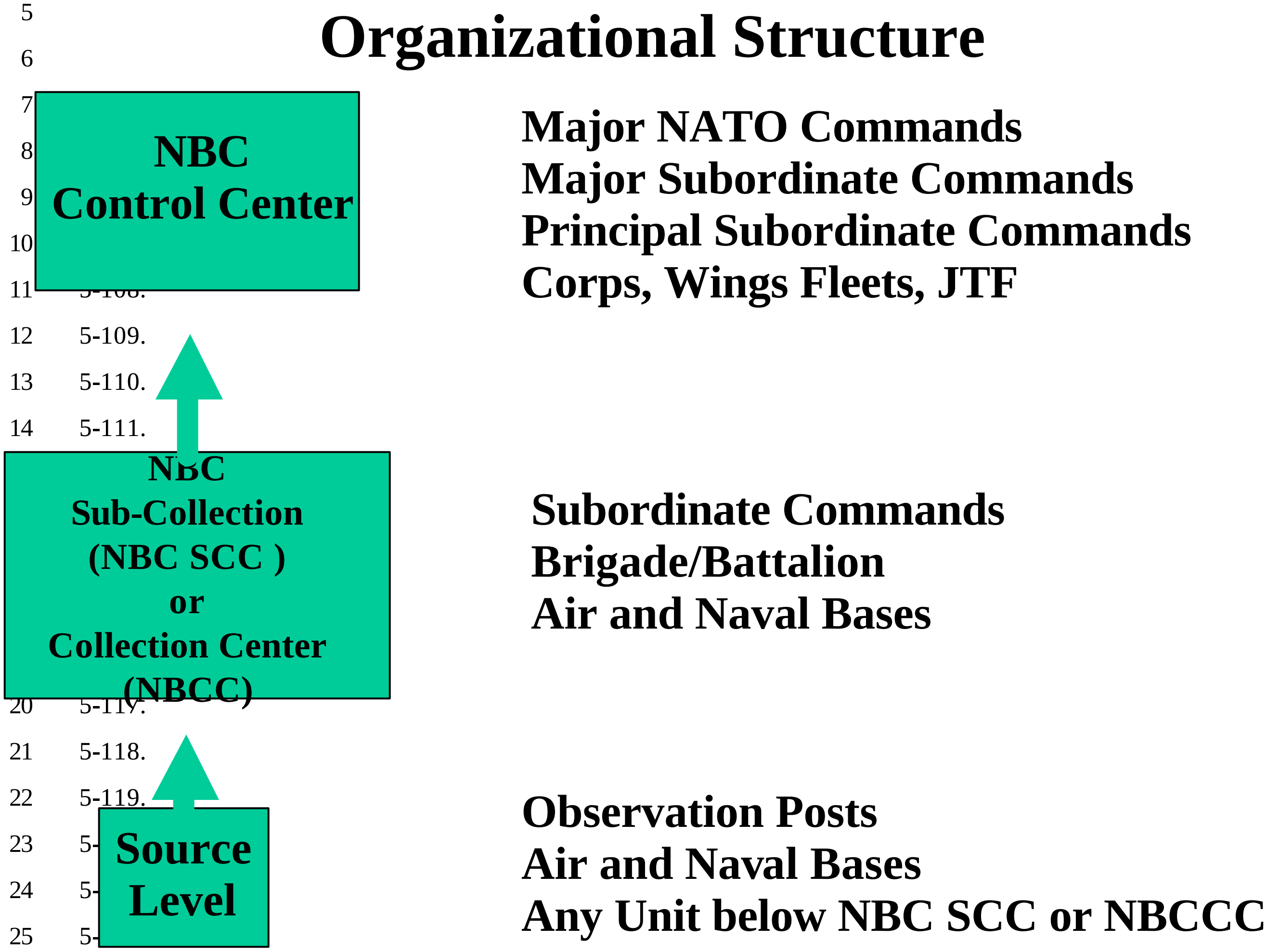
Designated Aerial Observers

5-101. Aircraft provide excellent observer coverage for nuclear attacks. The NBCC coordinates with the appropriate aviation officers to have several aircraft crews designated as observers. The aviation unit commander selects the crews. Designated aircrews are instructed to report data about the type of attack and when and where it occurred. If aviators measure cloud parameters, they must also provide estimate crater width. Such data is usually not obtainable from ground observer units.

Nondesignated Observers

5-102.All units are required to record (in the prescribed format) their observations concerning nuclear strikes. Nondesignated observer units or any units that have not been specifically tasked will transmit their reports only on request. However, these units must report a nuclear attack only to the next higher headquarters according to local SOP.

5-103. NBCWRS Structure has been divided up into the following categories: source, NBC sub-collection centres, NBC collection centres and NBC control centres.



5-109.

5-110.

5-111.

5-118.

5-119.

5-123.

Figure 5-1

5-124.

5-125. Source Level. Observation Posts (Ops) and any unit below the NBC Sub-collection Centres fall into this category. The responsibilities of the Source Level are:

5-126. Report the Initial enemy use of nuclear, biological or chemical weapons by the most expeditious means available. (NBC 1).

5-127. Report immediately any further NBC attacks and subsequent data to the NBC sub-collection or NBC collection center. (NBC 1).

5-128. Disseminate timely warnings of predicted hazard areas to enable forces to increase their NBC state or readiness, to conduct monitoring and to prepare for survey and decontamination. (NBC 3).

5-129. Report monitoring and survey results to the NBC sub-collection or NBC collection center. (NBC 4).

5-130. Submit detailed information on chemical or biological attacks on request. (NBC 6).

5-131. NBC Sub-Collection Centres and NBC Collection Centres. This is the NBCCC on air bases, corps and division headquarters, and sector operations centres. Their responsibilities include:

5-132. Report the initial enemy use of nuclear, biological and chemical weapons by the most expeditious means available in accordance with directives and standard operating procedures (SOPs). NBC 1).

5-133. Clarify, consolidate, and evaluate NBC attack data reported from the source level or other NBC Centres or agencies (NBC 1 and NBC 2).

5-134. Compute fallout predictions and chemical downwind hazards areas based upon processed NBC attack data and pass the appropriate warning to units likely to be affected. (NBC 3).

5-135. Direct survey efforts within its zone of observation.

5-136. Analyze survey and monitoring results and pass actual contaminated areas to units likely to be affected. (NBC4 and NBC 5).

5-137. Request and provide detailed information on nuclear, chemical and biological attacks as directed. (NBC 6).

5-138. Exchange NBC information with appropriate national military and civilian reporting agencies.

5-139. NBC Control Centre Level. Major NATO Commands, Major Subordinate Commands, and forward-deployed headquarters such as in SWA fall into this category. Their responsibilities include:

5-140. Report the initial enemy use of nuclear, biological and chemical weapons by the most expeditious means available in accordance with directives and SOPs. (NBC 1).

5-141. Clarify, consolidate, and evaluate NBC attack data reported from the source level or other NBC centres or agencies (NBC 1 and NBC 2).

5-142. Transmit promptly NBC warnings to adjacent HQ or agencies when predicted hazard areas extend beyond their own area of observation (NBC 3).

5-143. Exchange NBC information with appropriate national military and civilian authorities as arranged by directives and SOPs.

5-144. Organize and co-ordinate the NBC warning system within its area of observation by contributing to the war plans and issuing a comprehensive directive and/or SOP.

5-145. Submit reports to higher headquarters and adjacent agencies as required.

5-146.

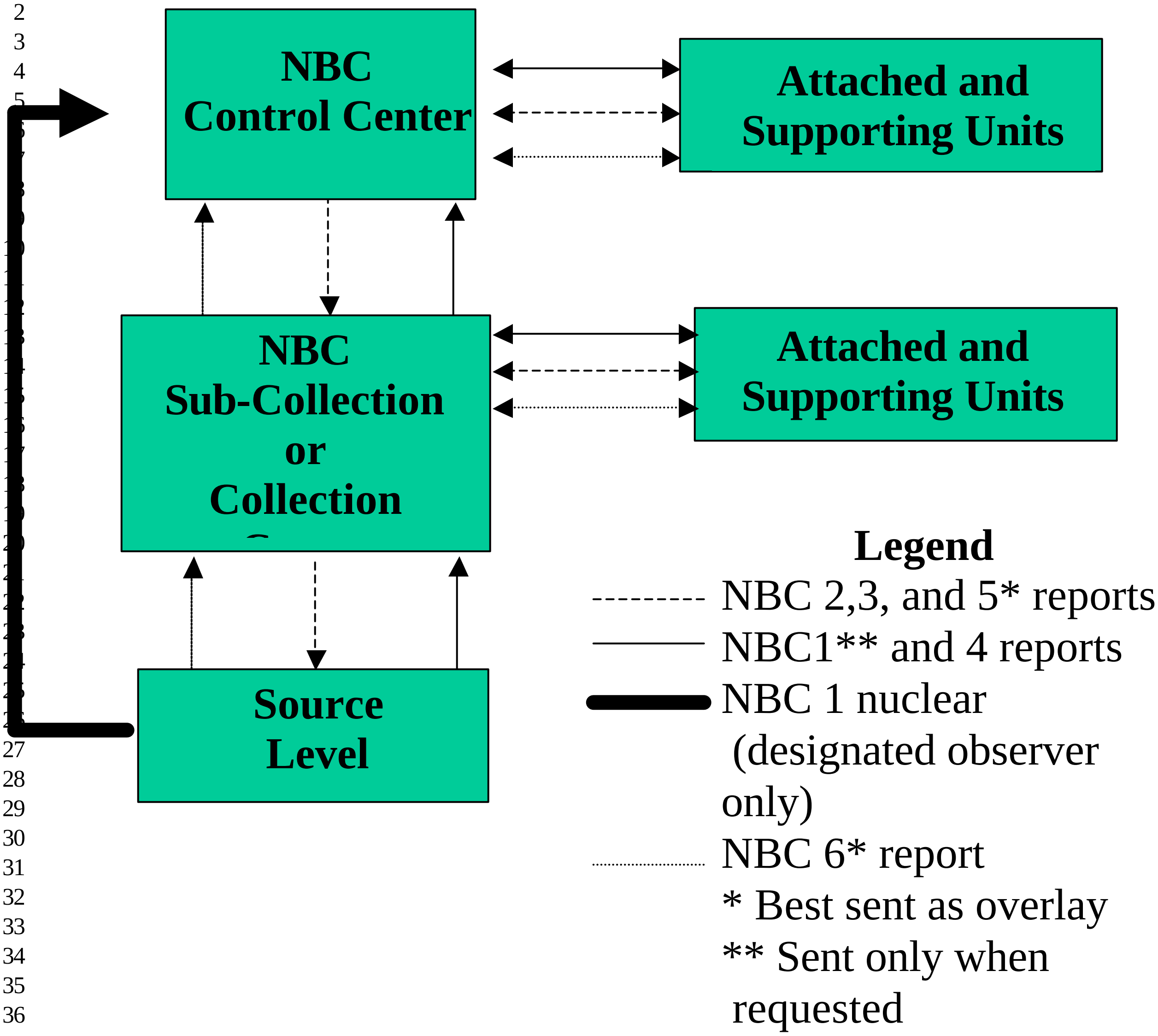


Figure 5-1 Flow of NBC reports.

Section XII - NBC Meteorological Data

5-147. Current meteorological data are a vital prerequisite for radiological fallout and biological, chemical and ROTA downwind hazard prediction. The meteorological service will collect data and distribute the messages described below. Meteorological data are transmitted as a NBC Wind Report.

5-148. NBC Effective Downwind Message (NBC EDM). These are messages containing information on downwind speed and downwind direction (towards which the wind is blowing) for each of seven preselected weapon yields.

5-149. Example:

NBC Effective Downwind Report (NBC EDR)

AREA (Area of Validity)

ZULU (Period of Validity)

UNIFORM (Units of Measurement)

ALFA (Effective Downwind for Yield Group ALFA)

BRAVO (Effective Downwind for Yield Group BRAVO)

CHARLIE (Effective Downwind for Yield Group CHARLIE)

DELTA (Effective Downwind for Yield Group DELTA)

ECHO (Effective Downwind for Yield Group ECHO)

FOXTROT (Effective Downwind for Yield Group FOXTROT)

GOLF (Effective Downwind for Yield Group GOLF)

5-150.

5-151. NBC Chemical (Biological) Downwind Message (NBC CDM). These are messages containing basic meteorological information for predicting biological aerosol and chemical vapour hazard areas.

5-152. Example:

NBC Chemical Downwind Message (CDM)

AREA (Area of Validity)

ZULU (Period of Validity)

UNIFORM (Units of Measurement)

WHISKEY (Surface Weather for the first two hour Period)

XRAY (Surface Weather for the second two hour Period)

YANKEE (Surface Weather for the third two hour Period)

5-153.

5-154.

5-155. ISSUE: When we receive an NBC report that we later assess to be false. How do we pass that back to the reporting unit???

Chapter 6

NBC Modeling and Simulation

"A picture is worth a thousand words"

unknown

Computer models take user input to drive calculations and databases to produce an output. This output, when modeling NBC/TIM events, can provide a map overlay or visual estimate of release area and hazard cloud travel and it's possible effects However, input completeness and accuracy drives the output.. Weather, terrain, agent characteristics, and delivery means all may significantly affect model output. Additionally, the capability and sophistication of the model also affects the value of the output. All models have inherent limitations and errors. But as planning tools in the hands of an experienced operator, they can provide an estimate/assessment to assist the commander in the decision making process – primarily before release events occur. They can also assist the staff in planning reconnaissance and surveys when other data is not available.

Simulations generally consist of a suite of models – each model focused on performing a small segment of an overall depiction of reality. Warfighting simulations can provide strategic through tactical training to commanders and staffs throughout the Services; most often focused on a particular echelon of command. Equipment simulation systems are used to train pilots, NBC reconnaissance personnel and armored vehicle perators in specific task performance. Use of simulations has grown and will continue to expand to address the needs of the Services as they develop new technology and operational procedures.

SECTION I – PREDICTIVE MODELING

6-1. Representing the dissemination of NBC agents and the release of TIMs present a wide range of challenges to modelers. In many cases, agents are dispersed as liquids that are toxic as both liquids in the release area and as gases or vapors downwind. Any model used to depict a release must accoount for where the liquid agent goes after it is disseminated as well as the rate of evaporation of the liquid. Since evaporation is also affected by the surface, it is difficult to model those surfaces which are rough such as forests or large cites with multistory buildings. Models vary widely in their level of addressing their environments and should be used to augment information developed to address NBC/TIM events.

6-2. The Department of Defense has three models which are designated as NBC hazard prediction models. Each of these has a specific application which is outlined below. As of the date of this manual, there is no single hazard preiction model or suite of models which will meet all DOD hazard prediction requirements. The base requirements of DOD are to model and assess the following hazards:

- CB attack hazards.
- NBC hazards from the destruction of NBC facilities.
- Hazards from industrial chemical accidents.

6-3. CB attack hazards are modeled using Vapor, Liquid, and Solid Tracking (VLSTRACK) which is under the proponency of the U.S. Navy. VLSTRACK provides approximate chemical and biological warfare hazard predictions for a wide range of chemcal and biological agents and munitions. The model features a windows interface for input of parameters and color graphics output.

6-4. NBC hazards from the destruction of NBC facilities are modeled using Hazard Prediction & Assessment Capability (HPAC). HPAC can predict hazards from nuclear, biological, chemical, and radiological weapons and facilities. The model features a windows interface for input of parameters and color graphics output.

6-5. Hazards from industrial chemical accidents and releases are modeled using D2PC. This model is also used by Army depots that store chemical munitions. Hazard assessment is made in terms of the accumulated dosage or peak concentration which may result from instantaneous, continuous, or varying release of the agent.

DOMESTIC PREPAREDNESS MODELS

6-6. The Consequences Assessment Tool Set (CATS) is an integrated disaster analysis system. CATS estimates damage and assesses consequences to population, infrastructure, and critical resources. CATS can assess consequences from both technological and natural hazards. Technological hazards include NBC weapons and chemical/nuclear facility accidents. Natural hazards include hurricanes and earthquakes. CATS is currently available to and being used by the Army National Guard Civil Support Teams (CST).

6-7. CATS combines state-of-the-art physical effects models, digital databases, a geographic information system, and an easy to use graphical interface.

6-8. Areal Location of Hazardous Atmospheres (ALOHA) is an emergency response model intended primarily for rapid deployment by responders. Model output is in both text and graphic format, and includes a footprint plot of the downwind area where concentrations may exceed a user designated threshhold level.

SECTION II – MODELS AVAILABLE FOR USE

6-9. There are a large number of models available through various DOD and other Federal agencies. Models are volatile and dynamic; therefore, considerable expertise is required is required to avoid misuse or misreading of the results. For additonal information on models, refer to the website of the Modeling & Simulation Information Analysis Center, www.msiac.dmso.mil.

Appendix A

Nuclear Tactics, Techniques and Procedures

Source Through NBCC Level Nuclear Operations Checklist

This appendix contains a series of checklists that outline how contamination avoidance tactics, techniques, and procedures (TTPs) can be applied all events involving radiological material. They apply to source through NBCC level elements. The various lists are designed to assist commanders and NBC Defense personnel in tactical operations. The TTPs included are not designed to replace individual service's training, evaluation plans or standards, nor any other listing of collective tasks, but are intended to be operational contamination avoidance checklists. These checklists are not all-inclusive and may be adapted or modified for local use.

SECTION 1 - PREPARE FOR OPERATIONS IN AN NBC ENVIRONMENT

A-1. The following specifics apply:

- Enemy is capable of offensive nuclear weapons or access to radiological materials.
- NBC threat status (nuclear) is Serial 1 (Serial designations are outlined in Appendix E of FM 3-11) or higher. Serial 1 indicates slight capabiltity in NBC weapons.
- Nuclear weapons/radiological dispersion use is considered to be a likely course of enemy action.
- Unit is provided intelligence reports on enemy capabilities.
- Authorized unit detection and individual protective equipment is on hand, operational, and issued per unit SOP.

A-2. Unit equipment shortages are placed on order. Monitoring equipment not calibrated is sent to TMDE for calibration.

A-3. OPSEC, dispersion, and cover and concealment are practiced to avoid being targeted.

A-4. Commander analyzes mask-only posture vs MOPP as a protective measure for troops in a radioactively contaminated environment.

A-5. Unit receives and correctly interprets periodic effective downwind messages.

A-6. Unit adopts NBC contamination avoidance measures. Such as-

- Cover supplies and equipment with NBC protective covers.
- If the unit is in a stationary position and is expected to remain in position for more than one hour, personnel should improve fighting positions with overhead cover.
- For nuclear weapon's yields, identify nonessential communication assets that can be disconnected and stored in case of an imminent attack.

A-7. Same as source level actions, plus -

- Ensure subordinate units follow SOPs.
- Ensure EDMs are sent to subordinate units.

SECTION 2 – PREPARE FOR A NUCLEAR WEAPONS ATTACK

A-8. The following specifics apply:

- The enemy has employed nuclear weapons in theater
- NBC Threat status (nuclear) is Serial 2 or higher.
- Higher headquarters INSUM indicates the enemy is likely to use nuclear weapons on or near your unit.

A-9. Alert subordinate units.

A-10. Start periodic monitoring

A-11. Unit continues the mission while implementing actions to minimize casualties and damage.

A-12. Personnel, equipment, munitions, POL, food, water, and nonessential communications equipment are protected from the effects of nuclear weapons.

A-13. Ensure unit has updated EDM on hand.

A-14. OPSEC, dispersion, and cover and concealment are practiced to avoid being targeted and to minimize the effects of an attack.

A-15. Alert subordinate units and elements.

A-16. Ensure headquarters and subordinate units take protective measures outlined in SOPs.

A-17. Ensure subordinate units have received the most current EDM.

A-18. Alert servicing aid station on potential mass casualties.

A-19. Ensure radiation monitors are prepared for operations.

SECTION 3 – RESPOND TO A NUCLEAR WEAPONS ATTACK

A-20. The unit or a subordinate unit(s) is subjected to a nuclear attack.

A-21. All personnel immediately take protective action as outlined in relevant service publications

A-22. Flash to bang time time is recorded.

A-23. Designated observer units record cloud width at H+5 minutes or cloud-top or cloud-bottom angle at H+10 minutes.

A-24. The chain-of command and communications are restored, and the unit continues with the mission.

A-25. Casualties and damage are assessed. Casualties are cared for and evacuated. Higher HQs is informed of the situation. Casualties and damaged equipment are reported to higher HQ.

A-26. Unit identifies type of burst and potential location of ground zero and submits an NBC 1 nuclear report.

A-27. Start continuous monitoring, and reports the arrival of fallout (NBC 4 INITIAL nuclear report).

A-28. Ensure unit personnel-

- Prepare for follow-on enemy attack.
- Protect themselves from the effects of fallout and fires that may be started.
- Protect respiratory tracks from the inhalation hazards of fallout by either wearing the protective mask or by placing a cloth over noses and mouths.
- Remove radioactive contamination by brushing, shaking, or washing contamination from personal equipment.

A-29. Report INCREASING, DECREASING, OR PEAK dose rates. Report the completion of fallout.

A-30. Receive from higher HQ an NBC 2 nuclear report. Prepare a simplified fallout prediction, and inform the commander.

A-31. Re-establish chain-of-command and communications network.

A-32. NBC 1 reports are consolidated to form an NBC 2 report. Estimate yield based on NBC 1 report information and determine resolved yield. The NBC 2 report is posted to the situation map as an overlay to identify GZ. The report is passed to subordinate, adjacent, and higher units.

A-33. NBC 1 (follow-up) report is requested from designated observer units, if applicable, to identify the cloud-width or cloud-top bottom angle. The hazard area is predicted and disseminated to subordinate/slice units via NBC 3 report received from higher headquarters.

A-34. Ensure subordinate units report the arrival of fallout and all subsequent monitoring reports. Forward this information to higher headquarters.

A-35. Subordinate unit damage assessment is evaluated. If required, assistance is provided to the unit for reestablishing command an control. This report is passed to the next higher headquarters.

A-36. Decontamination requirements are determined based onoperational needs, extent of contamination, and availability of assets.

A-37. If decontamination is required and operational conditions permit, a decontamination request is prepared and submitted IAW SOP. Decontamination priorities are determined and followed, in either case.

A-38. Contingency stocks are reordered to replace used stocks and/or to support decon operations.

A-39. Provided additional assistance or information to the servicing NBCC, as required, to determine location of GZ, yield, and decay rate.

SECTION 4 - CONDUCT POST NUCLEAR WEAPONS ATTACK OPERATIONS

A-40. Unit has reestablished communications and chain of command following the attack.

A-41. Local fires are controlled, debris is cleared away, casualties assessed, treated and evacuated.

A-42. Unit continues monitoring and submits scheduled reports on radiation level in the area.

A-43. If the unit must continue to operate in the area, the unit should continue to-

- determine actual location of GZ, and define the extent of the hazard.
- protect personnel by limiting their exposure to radioactive materials. Be alert for transient contamination, the spreading or movement of contamination by natural sources.

A-44. Ensure subordinate units have –

- Reestablished chain of command and communications.
- Cared for and evacuated casualties.
- Controlled local fires and cleared debris.
- Continued monitoring for radiation hazard.

A-45. EDMs Ensure subordinate units are recovering, but are also prepared for a potential follow-on enemy attack.

SECTION 5 - RESPOND TO A NUCLEAR FALLOUT PREDICTION

A-46. The following specifics apply:

- Unit has received an NBC 2 or 3 report from higher HQ.
- Unit has received or prepared a current EDM.

A-47. Unit continues the mission.

A-48. Plot NBC report information on situation map. Notify commander of the significance of the plot to unit operations.

A-49. If the unit's position lies within the predicted hazard area-

- Start continuous monitoring. Notify higher headquarters when fallout arrives at unit location.
- Ensure all supplies, equipment, and personnel are protected from fallout contamination.
- Brief commander on cloud arrival time.
- Update higher headquarters of current dose rate and RES category.

A-50. Unit remains in place, gathers monitoring data, and passes it to higher headquarters.

A-51. Unit continues the mission.

A-52. Plot NBC 2 or 3 on the situation map, and brief the commander on the tactical significance of the prediction.

A-53. Identify any subordinate units within the fallout prediction or if future missions will require operations within that area.

A-54. Calculate the possible time for arrival of fallout.

A-55. Pass on NBC 2 or 3, OEG, and EDM to subordinate units.

A-56. Ensure subordinate units-

- Initiate protection procedures IAW SOP to protect again potential fallout.
- Start continuous monitoring.
- Have current EDM.

A-57. Receive monitoring reports from subordinate units. Post information to situation map. Relay reports to the NBCC. Advise NBCC on RES of units.

A-58. Calculate decay rate , if required, and the preparation of Monitor/Survey/Recon Teams to support the NBC 4 report.

SECTION 6 – PREPARE TO RESPOND TO THE USE OF A RADIATION DISPERSAL DEVISE (RDD)

A-59. The following specifics apply:

- The enemy has employed radiation despersla devices (RDD) in theater
- NBC Threat status (nuclear) is Serial 2 or higher.
- Higher headquarters INSUM indicates the enemy is likely to use RDD on or near your unit.

A-60. Alert subordinate units.

A-61. Start periodic monitoring

A-62. Unit continues the mission while implementing actions to minimize casualties and damage.

A-63. Personnel, equipment, munitions, POL, food, water, and nonessential communications equipment are protected from the effects of RDD.

A-64. OPSEC, dispersion, and cover and concealment are practiced to avoid being targeted and to minimize the effects of an attack.

A-65. Alert subordinate units and elements.

A-66. Ensure headquarters and subordinate units take protective measures outlined in SOPs.

A-67. Alert servicing aid station on potential mass casualties.

A-68. Ensure radiation monitors are prepared for operations.

SECTION 7 – RESPOND TO AN RDD ATTACK

A-69. The unit or a subordinate unit(s) is subjected to use of a RDD.

A-70. All personnel immediately take protective action as outlined in relevant service publications

A-71. Casualties and damage are assessed. Casualties are cared for and evacuated. Higher HQs is informed of the situation. Casualties and damaged equipment are reported to higher HQ.

A-72. Unit identifies potential location of the RDD and submits an NBC 1 nuclear report.

A-73. Start continuous monitoring, and reports the arrival of fallout (NBC 4 INITIAL nuclear report).

A-74. Ensure unit personnel-

- Protect themselves from the effects of fallout and fires that may be started.
- Protect respiratory tracks from the inhalation hazards of fallout by either wearing the protective mask or by placing a cloth over noses and mouths.
- Remove radioactive contamination by brushing, shaking, or washing contamination from personal equipment.

A-75. Report INCREASING, DECREASING, OR PEAK dose rates. Report the completion of fallout.

A-76. Receive from higher HQ an NBC 2 nuclear report. Prepare a simplified fallout prediction, and inform the commander.

A-77. Re-establish chain-of-command and communications network.

A-78. NBC 1 reports are consolidated to form an NBC 2 report. Estimate area of contamination based on NBC 1 report information and determine the dose rate in the effected area. The NBC 2 report is posted to the situation map as an overlay to identify the contaminated area. The report is passed to subordinate, adjacent, and higher units.

A-79. Ensure subordinate units report the arrival of fallout and all subsequent monitoring reports. Forward this information to higher headquarters.

A-80. Subordinate unit damage assessment is evaluated. If required, assistance is provided to the unit for reestablishing command an control. This report is passed to the next higher headquarters.

A-81. Decontamination requirements are determined based onoperational needs, extent of contamination, and availability of assets.

A-82. If decontamination is required and operational conditions permit, a decontamination request is prepared and submitted IAW SOP. Decontamination priorities are determined and followed, in either case.

A-83. Contingency stocks are reordered to replace used stocks and/or to support decon operations.

A-84. Provided additional assistance or information to the servicing NBCC, as required, to determine location of contamination, dose rate and decay rate.

SECTION 8 - CONDUCT OPERATIONS AFTER USE OF A RDD

A-85. Unit continues monitoring and submits scheduled reports on radiation level in the area.

A-86. If the unit must continue to operate in the area, the unit should continue to-

- determine actual location of contamination, and define the extent of the hazard.
- protect personnel by limiting their exposure to radioactive materials. Be alert for transient contamination, the spreading or movement of contamination by natural sources.

A-87. Ensure subordinate units have –

- Reestablished chain of command and communications.
- Cared for and evacuated casualties..
- Continued monitoring for radiation hazard.

A-88. Develop an NBC 5 report and submit to subordinate and adjacent units showing the extent of contamination from the RDD.

SECTION 9 - OPERATE IN A RADIOLOGICAL CONTAMINATED AREA

A-89. The unit remain in a contaminated environment.

A-90. Unit continues the mission.

A-91. Ensure the following procedures are conducted until the unit is able to leave the contaminated environment:

- Remain in protective posture or protected positions until higher headquarters determines the optimum time for exit.

- Continue monitoring reports are submitted (NBC 4) to refine radiation area parameters.
- Additional shielding is added to protective positions to reduce the total dose received.
- Clean areas are located where personnel can be rotated.
- NBC 5 nuclear report is received and plotted. Advise the commander on the impact of unit mission.

A-92. Post NBC 5 report to situation map. Advise commander on the tactical implications of the contaminated area. This briefing should cover-

- Any subordinate units within the contour lines of the contaminated area.
- How long the unit can stay in this area and not exceed the OEG. This is based on total dose calculations and/or optimum time of exit calculations. To perform these calculations, assistance may be required from the NBCC.
- Period of validity for the NBC 5 report.
- In coordination with the staff intelligence and security identify possible enemy courses of action.

A-93. Ensure subordinate units are aware of the commander's decision, NBC5, tactical implications, and optimum time of exit.

A-94. Ensure subordinate units continue to monitor radiation levels, report casualties, and provide IAW SOP.

A-95. Ensure unit evacuates the area at the appropriate time and IAW SOP.

SECTION 10 – CROSS A NUCLEAR CONTANIMATED AREA

A-96. The following specifics apply-

- Given an NBC 5 nuclear report, period of validity, decay rate, and OEG from higher HQ.
- Unit is required to cross area.

A-97. Unit radiation monitoring equipment is zeroed and issued to appropriate operators.

A-98. Unit leaders ensure vehicles are prepared to cross contaminated area by adding additional shielding (sandbag floor, etc.).

A-99. Unit personnel don protective masks or cover noses and mouths with cloths to reduce inhalation hazards. Unit personnel may don MOPP 4 to reduce contamination from fallout.

A-100. Unit coordinates potential decontamination of vehicles and personnel after crossing.

A-101. If unit possess or has access to an NBC recon vehicle, this vehicle should be used by the advanced party.

A-102. Unit crosses contaminated area as quickly as possible while following the most expeditious route available.

A-103. Continuously monitor the environment, while crossing, and record radiation exposure.

A-104. Report radiation exposure and crossing completion to higher headquarters.

A-105. Request unit decontamination if mission permits.

A-106. Post the NBC 5 report to the situation map.

A-107. Review operation order and determine-

- If the unit must cross the contaminated plot to accomplish the mission.
- What mode of transportation will be used to cross.
- At what time does the unit have to start crossing.
- How long does the unit have to cross.

A-108. Calculate the total dose the unit is expected to receive.

A-109. Contact the admin section and obtain RES of crossing unit.

A-110. Add total dose calculated to the RES. IF the expected total dose and current RES are more than stated OEG-

- Rework total dose estimates with a delay in crossing, faster road speed while crossing, or by choosing a new route with lower dose rates.
- Calculate the effects of additional shielding added to the vehicles.
- Brief the commander on findings.
- Ensure crossing unit-
- Crosses contaminated area IAW SOP.
- Receive total dose reports from the unit. Pass reports to higher HQ and others as required by SOP for inclusion in the RES report.
- Coordinate for decon support, if required and if situation permits.

SECTION 11 - CONDUCT OR SUPERVISE A RADIOLOGICAL SURVEY

A-111. The following specifics apply:

- Higher headquarters directs a survey of the area of operations be conducted.
- Areas of interest within the unit's operational area may be contaminated.
- The tactical situation requires the unit to conduct a survey.

A-112. Unit NBC defense Team briefs commander on the tactical implications of conducting the Survey.

A-113. Subordinate element best suited , due to operational capabilities of unit, is tasked to perform survey.

A-114. Unit NBC Defense Team or higher guidance from the requesting headquarters briefs survey team. Briefing includes but is not limited to the following:

- Type of recon and/or techniques to be employed.
- Reporting requirements
- Marking requirements
- Special preparation of vehicle to enhance contamination avoidance.
- Turn-back dose or dose rate.
- Operational exposure guidance

A-115. Survey team(s) execute mission as directed.

A-116. NBC defense team submits evaluated data to higher headquarters

A-117. Unit decontaminates as required.

A-118. Unit receives the mission request and/or determines the area to be surveyed. Request support from an NBC reconnaissance unit, if possible.

A-119. Ensure subordinate unit initiates, conducts, and reports survey data IAW guidance from the requesting headquarters and unit SOP. Ensure turn-back dose dose-rate and OEG are covered in briefing.

A-120. Alert the supporting chemical unit to the potential need for decontamination of survey party. If there is no supporting chemical unit coordination is made with higher headquarters for support.

A-121. Identify potential decontamination sites (if required).

A-122. Ensure subordinate unit submits the NBC 4 report as required by SOP. The report is received, logged in, checked for accuracy, and forwarded to higher headquarters.

A-123. Survey finding are posted or annotated on the situation overlay IAW SOP.

A-124. RES of the survey party is passed on IAW SOP.

A-125. The following specifics apply:

- Subordinate unit(s) reports radiological contamination.
- Personnel wipedown and operator spraydown have been completed.

A-126. Unit determines the extent and numbers of contaminated personnel and equipment.

A-127. Unit requests decon support and coordinates for chemical protective clothing, and supplies for thorough troop decon.

A-128. Unit designates decon team, moves to the assembly area, which is downwind from the decon site, links up with the decon unit, and receives a briefing on the decon site operation.

A-129. Unit conducts thorough troop decon and sends equipment to the thorough equipment decon site as instructed by the decon unit's OIC or NCOIC.

A-130. Unit conducts thorough troop decon for the decon unit after it completes its mission and it closes the vehicle decon site.

A-131. Unit completes reconstitution and resumes or awaits the next mission.

A-132. Subordinate unit requests decontamination IAW SOP.

A-133. The commander is briefed on the type and extent of contamination, how long the contaminated unit can stay in the current posture without further decontamination, the availability of decon unit support, and a recommendation on which decon should be done.

A-134. The commander decides if the unit will initiate decontamination operations, and if so, whether the decontamination will be Operational or Thorough. The decision is based on operational capabilities and the advice from higher headquarters.

A-135. After decontamination units order replacement contingency stocks used during decontamination.

SECTION 12 – EVACUATE RADIOLOGICAL COMTAMINATED CASUALTIES

A-136. The unit has sustained casualties that are radiologically contaminated.

A-137. Unit requests medical evacuation based on normal considerations of medical care required and urgency. Evacuation requests are made IAW SOP.

A-138. Unit informs higher headquarters on how many casualties were sustained, and mode of evacuation.

A-139. Casualties are brought to evacuation transportation (aircraft or vehicles). Unit takes measures to limit the spread of contamination.

A-140. Each casualty is marked, identifying the type of contamination and first aid received.

A-141. Subordinate unit informs headquarters on the number of casualties, type and time of contamination and method of evacuation desired.

A-142. Notify subordinate unit designated to provide a detail for patient decontamination.

A-143. Medical support is notified of incoming casualties. Patient Decon team is on hand to assist with decontamination of casualties.

A-144. Notify the supporting NBC Defense unit or higher headquarters about the possibility of decon support for the evacuation vehicles.

A-145. Ensure a knowledgeable individual in NBC defense is on hand to assist in casualty decon. This individual will insure that contaminated casualties are off loaded from evacuation vehicles downwind of the medical site. This individual will also ensure that the crew of the vehicles or aircraft monitors for contamination.

ANNEX 1, APPENDIX A

YIELD ESTIMATION

AIM

A-1. The aim of this chapter is to describe the methods by which it is possible to estimate the yield of a nuclear detonation, based upon measurements and/or parameters reported from observers.

GENERAL

A-2. Estimation of the yield of a nuclear detonation requires observation results as contained in the observers' report (NBC 1 NUC). The observers must report as much of the data as possible, subsequent reports can be sent, as more details become available.

A-3. The yield of the detonation may be estimated by using the data contained in the sets JULIET, LIMA and MIKE as entrance figures in the nomograms in Annex 6 to Appendix A, Figures A.6-I, A.6-II and A.6-III.

A-4. It should be noted that, when the distance from an observer to GZ has been determined, this distance should be used rather than the flash-to-bang time, when using the nomograms in Figure A.6-I and A.6-II.

A-5. The methods will be described in the following paragraphs of this chapter.

- a. Distance from Observer to Ground Zero (GZ) or Flash-to-Bang Time and Angular Cloud Width (Figure A.6-I).
- b. Distance from Observer to GZ or Flash-to-Bang Time and Cloud Top and/or Cloud Bottom Angle (Figure A.6-II) (Ground bursts or unknown only).
- c. Height of stabilised cloud top and/or cloud bottom (Figure A.6-III) (Ground bursts or unknown only).

DISTANCE FROM OBSERVER TO GZ OR FLASH-TO-BANG TIME AND ANGULAR CLOUD WIDTH.

A-6. When distance from observer to GZ or flash-to-bang time and nuclear burst angular cloud width (measured at five minutes after burst) are known, enter the nomogram Figure A-I with a straight-edge or line at the measured data in the angular cloud width and flash-to-bang/distance to ground zero columns, and read the yield, where the straight-edge or line intersects the yield column.

<u>Example:</u>

Reported data:

Flash-to-bang time: 60 seconds
Angular cloud width: 275 mils

From Figure A-I determine yield as **50 KT.**

Note: The Flash-to-bang time should only be used when the distance to GZ is not known.

DISTANCE FROM OBSERVER TO GZ OR FLASH-TO-BANG TIME AND CLOUD TOP AND/OR CLOUD BOTTOM ANGLE.

A-7. When distance from observer to GZ or flash-to-bang time and cloud top and/or cloud bottom angle (measured at ten minutes after burst) are known, use nomogram Figure A.6-II. Place a straight-edge or line at the measured data on the distance to ground zero/flash-to-bang and angle to top or bottom of cloud columns and read yield where the straight-edge or line intersects the yield cloud top or bottom columns as appropriate.

<u>Example:</u>
Reported data:
Distance from observer to GZ: 34,5 km.
Cloud top angle: 20 degrees

From nomogram Figure A.6-II determine yield as: **50 KT**

Note: The Flash-to-bang time should only be used when the distance to GZ is not known.

HEIGHT OF STABILISED CLOUD TOP AND/OR CLOUD BOTTOM.

A-8. When height of cloud top and/or cloud bottom (measured at ten minutes after burst) is known, the nomogram Figure A.6-III is used. Enter the nomogram with a straight-edge or line, used horizontally with the measured cloud parameter (cloud top or cloud bottom). Should both values be available and not give the same yield, select the larger value of the yield.

<u>Example:</u>
Reported data:
Cloud top height: 12 200 metres
Cloud bottom height: 8 300 metres

From the nomogram Figure A-III determine yield of **40 KT** for 12 200 metres (cloud top height) and **50 KT** for 8 300 metres (cloud bottom height), so the **50 KT** yield is selected. The graph Figure A.6-XI is also usable for this purpose.

YIELD ESTIMATION IN SHIPS.

If stabilised cloud top height or cloud bottom height can be measured, the Figure A.6-XI may be used to estimate the yield. When cloud top or cloud bottom parameters are not available, ships will have to use the methods described in paragraphs A-7 and A-8.

ANNEX 2, APPENDIX A

FALLOUT PREDICTION IN GENERAL

Fallout Prediction Method.

A.2-1 For the preparation of a fallout prediction, the following must be available:

- Meteorological data.
- Estimated yield.

A.2-2 The necessary meteorological data will be available in the format of a NBC Basic Wind Message (NBC BWM) or a NBC Effective Downwind Message (NBC EDM).

A.2-3 The method of fallout prediction consists of two procedures, the detailed procedure and the simplified procedure, both of which are used to determine the extent of the warning area. Normally the detailed procedure is used by agencies having a meteorological capability, and subordinate units use the simplified procedure. The decision as to which procedure is to be used is left to the commanders concerned. These two procedures are described in Annex 3, Appendix A and Annex 4, Appendix A respectively.

A.2-4 The prediction of the fallout hazard area using the detailed procedure is more accurate. Although neither procedure precisely defines the extent of the fallout, the predicted fallout area, calculated by either method, indicates the probable limits to which fallout of military significance will extend. When statistics of wind variability are available, the variable angle method provides the opportunity of basing the prediction on a probability calculation.

A.2-5 The boundaries of the predicted fallout area are not dose rate contour lines, nor do they imply that all points within the enclosed areas will sustain dangerous fallout.

Definition of Fallout Area Zones.

A.2-6 The predicted fallout area consists of Zone I and Zone II.

- <u>Zone I is of Immediate Operational Concern</u>. Within this Zone, there will be areas where exposed, unprotected personnel may receive doses of 150 cGy or greater in relatively short periods of time (less than 4 hours after actual arrival of fallout). Major disruptions to unit operations and casualties may occur in some parts of this zone.
- <u>Zone II is a Secondary Hazard</u>. Within this Zone, the total dose received by exposed, unprotected personnel is not expected to reach 150 cGy within a period of four hours after the actual arrival of fallout. Within this zone, personnel may receive a total dose of 50 cGy or greater within the first 24 hours after arrival of fallout. Personnel with no previous radiation

exposure may be permitted to continue critical missions for as long as four hours after the actual arrival of fallout without incurring the 150 cGy emergency risk dose.

- Outside the two Zones. Outside the two predicted Zones, exposed, unprotected personnel may receive a total dose that does not reach 50 cGy in the first 24 hours after the actual arrival of fallout. The total dose for an infinite stay time should not reach 150 cGy.

Note: Prediction of fallout is to be regarded as an estimate only. Necessary preparations should be made to avoid the hazard if tactically possible. Even within Zone I, units may not be affected by fallout at all. However, the decision to act is up to the local commander and national directives/SOPs.

SIGNIFICANCE OF FALLOUT ASHORE VERSUS THAT AT SEA.

A.2-7 The detailed procedure and the simplified procedure for fallout prediction are intended for use by all services. They are based upon assumed land surface bursts. It is recognised that the fallout from a sea burst may be rather different, but very little direct information is available on fallout from bursts on the surface of deep ocean water.

A.2-8 It must be stressed that the sea acts like an absorbent of, and shield against, radioactive products, but they remain a hazard on land until they have decayed.

A.2-9 Another important difference is that recipients of warnings ashore do not have the mobility of ships at sea, and in most cases must deal with the danger "in situ". Therefore ships will be particularly interested in the determination of the approximate area in which deposition of fallout at the surface is taking place at a given time after burst.

A.2-10 Ships with a meteorological capability may be able to obtain the required meteorological data for computation of NBC EDM using standard pressure level winds. Basic wind data for this purpose are generally also available from meteorological sources (airbases, MET-ships or mobile weather stations). Ships, which do not have a meteorological capability, will normally predict fallout areas by using the simplified procedure.

A.2-11 The fallout warning system for merchant ships at sea is described in Chapter 5.

PREDICTION OF FALLOUT FROM ATOMIC DEMOLITION MUNITIONS (ADM).

A.2-12 Types of bursts normally applicable to Atomic Demolition Munitions (ADM) employment are surface bursts or subsurface bursts. The coverage of a residual radiation hazard area for a specific ADM detonation will depend largely on the depth of burial and selected yield.

A.2-13 The prediction procedure for ADM, slightly different from the normal detailed fallout prediction procedure, is not described in the ATP – 45.

MULTIPLE BURST FALLOUT.

A.2-14 No additional prediction procedure is available in the case of multiple burst fallout. The information obtained in areas where Zones overlap is to be interpreted as follows:

- The hazard classification of an area where fallout prediction patterns overlap should be that of the higher classification involved. That is an overlap area involving Zone I, should be designated Zone I, and an overlap area involving nothing more than Zone II should be designated Zone II.
- <u>Examples</u>:

(1) Zone I overlapping Zone I - designated Zone I.

(2) Zone I overlapping Zone II - designated Zone I.

(3) Zone II overlapping Zone II - designated Zone II.

(4) Zone II overlapping Zone I - designated Zone I.

ANNEX 3, APPENDIX A

FALLOUT PREDICTION; DETAILED PROCEDURE

THE DETAILED PROCEDURE

A.3-1 This procedure requires nuclear burst or target analysis information and meteorological data. A fallout wind vector plot is prepared each time new meteorological data is received. Effective downwind speed, downwind direction, and width of predicted zone are determined from the wind vector plot. Effective downwind speed, effective downwind distance of Zone I, stabilised cloud radius, and the direction of left and right radial lines are transmitted (NBC 3 NUC) to subordinate units for immediate warning of predicted contamination resulting from a nuclear detonation.

NBC BASIC WIND MESSAGE/FORECAST.

A.3-2 The NBC Basic Wind Message (NBC BWM) and the NBC Basic Wind Forecast (NBC BWF) meteorological message, contain information on the wind conditions, i.e. wind directions (from which the wind is blowing) and wind speeds in a number of layers from the surface of the earth to 30000 m altitude. Additionally, the zone of validity and time of measuring are stated.

A.3-3 The NBC BWM contains weather information for the following 6 hour period. The NBC BWF contains information for subsequent 6 hour periods.

A.3-4 Each layer has a thickness of 2000 m. The message begins with information on the wind conditions within the layer from the surface to 2000 m, then for the 2000 to 4000 m layer etc. A numerical identifier is used for each of the layers, beginning with 2 for the 0 m – 2000 m layer, 4 for the 2000 m – 4000 m layer etc.

A.3-5 The wind direction for each layer will be given with three digits (the direction from which the wind is blowing), and the wind speed with three digits. The unit of measurement will be indicated under set UNITM. Wind direction is normally given as Degrees/True North (DGT) and wind speed as Kilometers/Hour (KPH). (See Annex C).

A.3-6 The information may appear as either two blocks of three digits or one block of six digits:

Examples:

02 280030 or
02 280 030

A.3-7 All examples illustrating the detailed procedure for fallout prediction are related to the wind data given below.

EXAMPLE OF A NBC BASIC WIND MESSAGE.

OPER/DAILY//
MSGID/BWR//
UNITM/-/DGT/KPH/-//
NBCEVENT/BWM//
ZULUM/140000ZSEP1999/140400ZSEP1999/141000ZSEP1999//
AREAM/NFEA1//
LAYERM/02 265 020//
LAYERM/04 290 030//
LAYERM/06 300 035//
LAYERM/08 310 035//
LAYERM/10 330 040//
LAYERM/12 345 040//
LAYERM/14 355 035//
LAYERM/16 005 030//
LAYERM/18 015 025//
LAYERM/20 020 015//
LAYERM/22 020 020//
LAYERM/24 025 020//
LAYERM/26 025 020//
LAYERM/28 030 020//
LAYERM/30 030 025//

Figure A.3-I, Example NBC Basic Wind Message.
See further details in Annex B.

A.3-8 The example above will be used for the purpose of constructing a wind vector plot and a fallout prediction following the detailed procedure in the paragraphs to follow.

WIND VECTOR PLOT.

A.3-9 The information contained in the NBC BWM is used for the construction of a wind vector plot in the following way:

a. The wind directions given in the NBC BWM above are converted into <u>downwind</u> directions for each layer of height, by reversing the wind direction 180 degrees.

b. The wind speed of each layer as given in the NBC BWM is to be represented by a vector, the length of which is extracted from the appropriate table (Figure A.6-IV to A.6-IX in Annex A).

<u>Example:</u>
Prepare a wind vector plot to map scale 1:250000, using the meteorological information contained in the NBC BWM in (Figure A.3-I).
The lengths of the wind vectors are extracted from the table related to map scale 1:250000 and wind speeds in the units of km/h (Figure A.6-VIII).

Layer	Downwind Direction (degrees)	Length of Vector (cm)
2	**085**	**5.4**
4	**110**	**7.1**
6	**120**	**7.3**
8	**130**	**7.0**
10	**150**	**7.7**
12	**165**	**7.2**
14	**175**	**5.9**
16	**185**	**4.8**
18	**195**	**3.9**
etc.		

c. Label ground zero (GZ), grid north (GN), and from GZ draw a vector in the downwind direction of the layer 0 - 2000 m. The direction is 085 degrees. The length of the vector is 5.4 cm. Label the downwind end of the vector with the figure 2, and label the vector length alongside the vector.
This vector is now representing the downwind direction and the downwind speed within the height layer from the surface to 2000 m height. From the end of this vector, draw the next vector, the direction of which is 110 degrees and the length 7.1 cm. The downwind end of this vector is labelled 4, the vector thus representing downwind direction and downwind speed within the height layer 2000 m to 4000 m.
Proceed in the same manner, using all information given in the NBCBWM. The result will be a wind vector plot as shown in Figure A.3-II.

FALLOUT CALCULATION.

A.3-10 Having drawn the wind vector plot, now determine the parameters for cloud top, cloud bottom and 2/3 stem height from the nomogram in Figure A.6-III. Enter the nomogram with a straight-edge or line used horizontally, connecting the estimated or reported yield on the left and right yield index scale. At the same time extract the parameters for cloud radius and time of fall from the cloud bottom.

Example:

Reported yield: 50 KT

From Figure A.6-III determine the parameters for 50 KT:

Cloud top height	**12 700 metres**
Cloud bottom height	**8 300 metres**
2/3 stem height	**5 500 metres**
Cloud radius	**5 kilometres**
Time of fall	**2.35 hours**

Proceed as follows, using the wind vector plot on Figure A.3-II:

a. Radial Lines. Label the points representing the cloud top height, cloud bottom height and 2/3 stem height on the fallout wind vector plot (see Figure A.3-III).
Draw radial lines from GZ through these points.
Disregard all wind vectors at altitudes below the 2/3 stem height and above the cloud top height point for the prediction being prepared. If wind vectors between these points

fall outside the radial lines drawn from GZ to these points, expand the angle formed by the radial lines, to include these outside vectors.

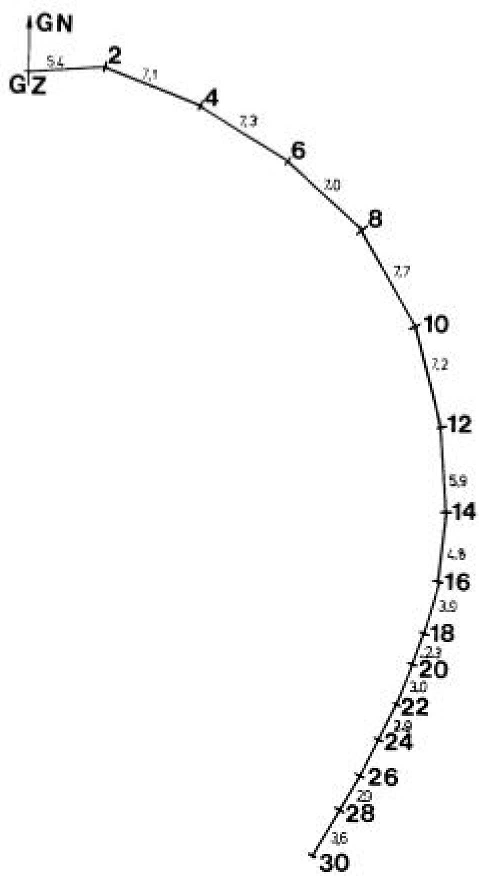


Figure A.3-II, Wind Vector Plot.

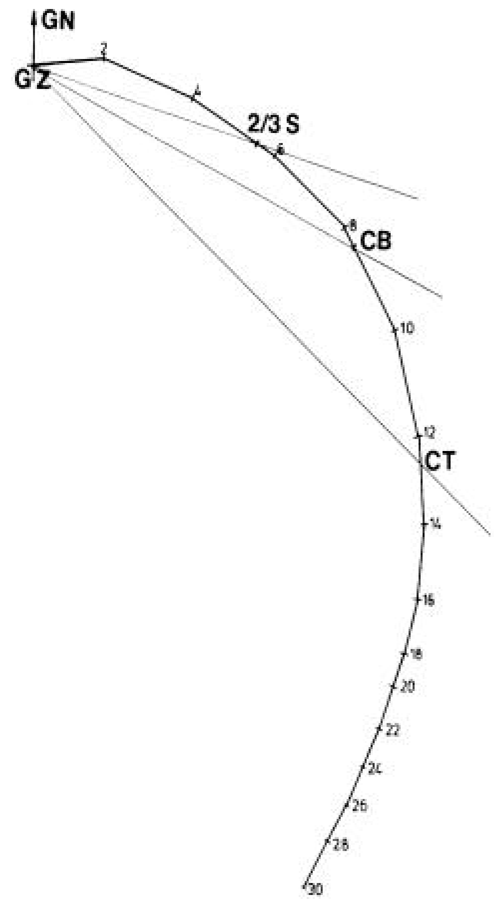


Figure A.3-III, Wind Vector Plot with Cloud and Stem Radial Lines (50 KT).

b. Determine the effective Downwind Direction: Bisect the angle formed by the radial lines GZ to cloud top height and GZ to 2/3 stem height. (See Figure A.3-IV).
The orientation of the bisector defines the effective downwind direction.
In the case where the angle of the radial lines has been expanded, the bisector will be d rawn using the expanded angle.

c. Determine the Sector Angle by using one of the following Methods:

(1) Fixed Angle. If the angle formed by the radial lines (GZ to cloud top height and GZ to 2/3 stem height) is 40 degrees or greater, proceed to para A.3-10. If less than 40 degrees, bisect the angle and expand the angle formed by the two radial lines to 40 degrees,

20 degrees left and 20 degrees right of the bisector (Figure A.3-IV). In cases where the angle has been expanded (para A.3-10.), the expanded angle will be used.

NOT TO SCALE

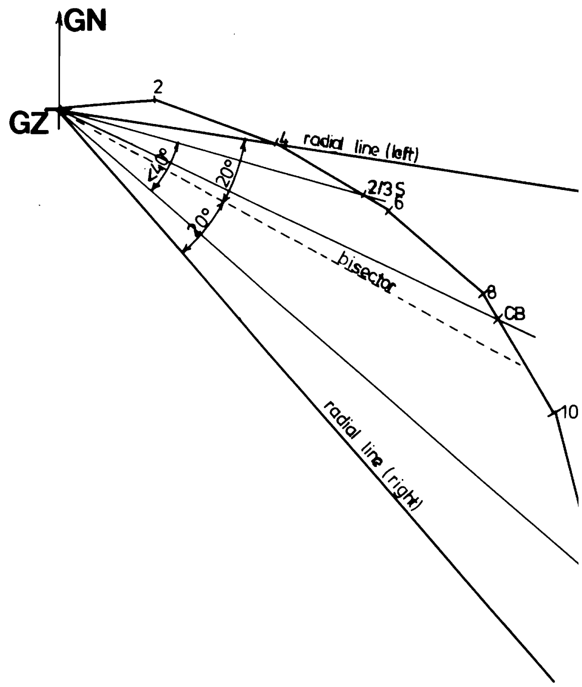


Figure A.3-IV, Wind Vector Plot with expanded Radial Lines.

(2) Variable Angle. This optional method is based upon a probability calculation. The user will decide the angular displacement. A table giving an example of angular variation as a function of effective wind speed and yield, using 80 % probability, is given in Figure A.3-V.

Note: NBC centers will determine which of the two procedures is to be used within their subordinate areas of command.

Effective Wind Speed (km/h)	**Half Sector Angle (degrees)**
8	**48**
10	**43**
12	**38**
14	**35**
16	**32**
18	**30**
20	**28**
22	**26**
24	**25**
26	**23**

28	**22**
30	**20**
35	**18**
40	**17**
45	**16**
50	**15**
55	**14**
60	**13**
70	**12**
80	**11**
90	**10**
100	**09**

Figure A.3-V, Angular Variation as a Function of Effective Wind Speed and Yield for the Northwest European Area.

Notes:

1. For optional use with locally measured Wind Data only.
2. The probability level of 80 % applies for 5 KT to 300 KT yields for the period November to March. For yields outside this range and for the period April to October, the probability will be higher than 80%.

d. Determine the Effective Downwind (EDW) Speed:
Measure the length of the radial line from GZ to the point for cloud bottom height, and convert the measured length to distance (km), using the map scale in which the wind vector plot is drawn. Read the time of fall from Figure A6-III corresponding to the cloud bottom and compute as follows:

$$\text{EDW speed} = \frac{\text{distance GZ to cloud bottom}}{\text{Time of fall}}$$

Example:
The distance measured from GZ to the point for cloud bottom is 26.8 cm, equal to 67 km when using map scale 1:250000. (1 km = 4 mm).

The time of fall from cloud bottom for 50 KT is 2.35 hours (Figure A.6-III), and the effective downwind speed is calculated as follows:

$$\textbf{EDW speed} = \frac{\textbf{67 km}}{\textbf{2.35 hours}} = \textbf{28.5 km/h}$$

e. Determine the Downwind Distances of Zone I and Zone II:
On the nomogram Figure A.6-X align a straight edge or line from the yield on the right hand scale to the wind speed scale. At the intersection of the straight-edge with the centre scale, read the value of the downwind distance of Zone I for a burst producing fallout. Multiply the Zone I distance by 2, to obtain the downwind distance of Zone II (distance from GZ to outer limit of Zone II).

Example:

Using the effective downwind speed (EDW speed) of 28.5 km/h and 50 KT yield, enter the nomogram Figure A.6-X, and determine the downwind distance of Zone I to be 40 km.
The downwind distance of Zone II is 40 km, multiplied by 2, equal to 80 km.
On the plot, using GZ as centre, draw two arcs with radii equal to the downwind distances of Zone I (40 km) and Zone II (80 km) respectively, between the two radial lines (see Figure A.3-VI).

f. Determine the Cloud Radius:
Obtain the cloud radius (km) from the nomogram in Figure A.6 -III, and draw a circle around GZ, using this radius.

Example:
Continuing the example used in para A.3-10, the cloud radius for a 50 KT weapon is 5 km (from Figure AIII). On the plot, draw a circle using GZ as centre and 5 km (20 mm) as radius (Figure A.3-VI).

g. Determination of Zone I and Zone II boundaries:
Draw two lines tangent to the cloud radius circle, and intersecting the points on the radial lines where the Zone I downwind distance arc intersects these lines. (Figure A.3-VII).
The Zone I downwind distance arc, the two tangent lines and the upwind cloud radius semi-circle form the boundaries of Zone I. The Zone II distance arc, the Zone I distance arc and the two radial lines form the boundaries of Zone II.

NOT TO SCALE

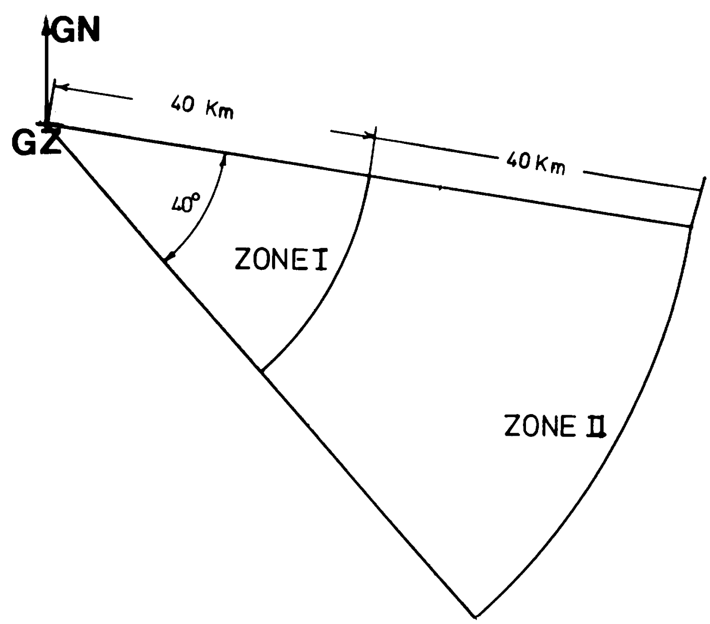


Figure A.3-VI, Radial Lines, Cloud Radius Circle and Zone I and Zone II Arcs.

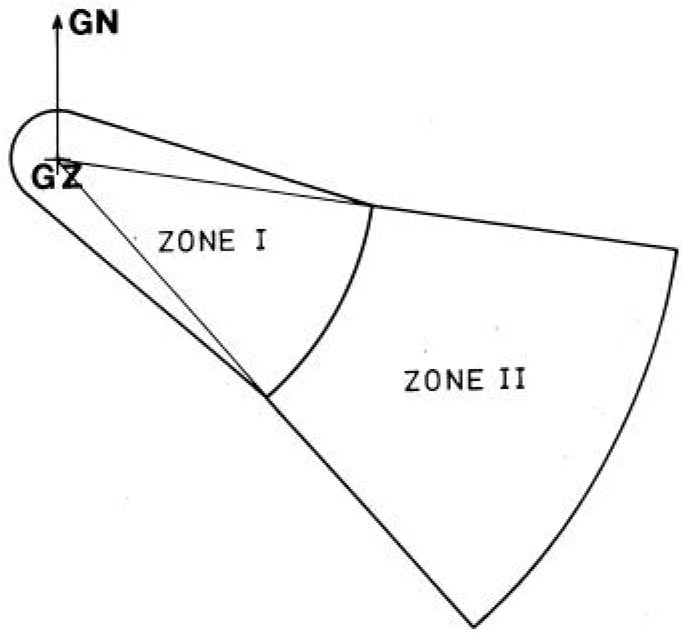
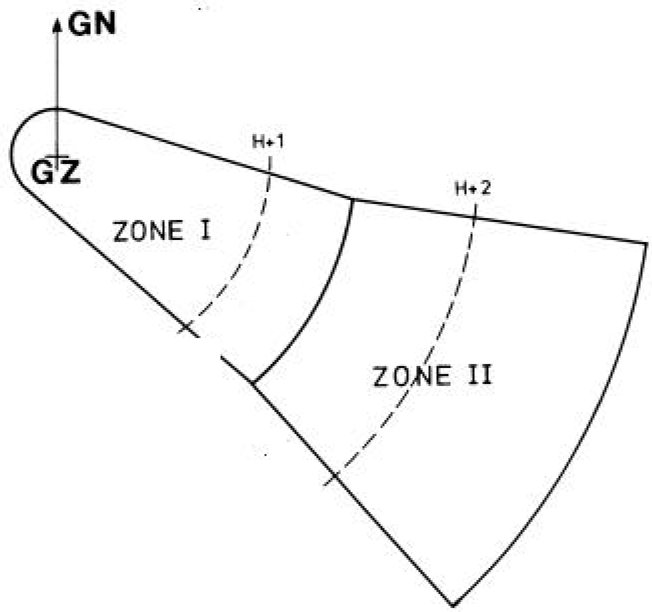


Figure A.3-VII, Cloud Radius Circle and Tangent Lines.

Weapon Yield	50 KT
Basic Wind Message	140400Z
Date-time of Attack	140608Z
Location of Attack (GZ)	NB157486 ACTUAL
Effective Downwind Speed	28.5 km/h
Map scale	(as appropriate)



NBC 3 NUC (ADP version):
OPER/BULTON//
MSGID/NUC3/TFW.20/14/JAN//
REF/A/NBC2/TFW.19/14/MAR/1999//
NBCEVENT/NUC//
ALFA/UK/310/UK1-03004/N//
DELTA/140608ZMAR1999//
FOXTROT/32UNB157486/AA//
NOVEMBER/50//
PAPAR/029KPH/040KM/05KM//100DEG/140DEG//

Figure A.3-VIII, Completed Detailed Fallout Prediction Plot and NBC 3 NUC.

h. <u>Time of Fallout Arrival</u>:
Using GZ as centre, indicate the estimated time of arrival of fallout by drawing dotted arcs downwind of GZ, at distances equal to the product of the effective downwind speed and each hour (or fractions of hour) of interest.

<u>Example</u>:
Effective downwind speed is 28.5 km/h, therefore it is estimated that fallout will arrive 28.5 km downwind from GZ at one hour after the burst (H+1) and 2 x 28.5 = 57 km downwind from GZ at two hours after the burst (H+2). Draw the two dotted arcs, using GZ as centre and 28.5 and 57 km as radii, and label the arcs "H+1" and "H+2" respectively. (See Figure A.3-VIII).

i. <u>Complete the Fallout Plot</u>:
Label the plot to indicate the map scale used, the yield (estimated or actual), date-time of attack, location of attack and NBC BWM used for preparation of the wind vector plot (see Figure A.3-VIII).

SPECIAL CASE.

A.3-11 When the effective downwind speed is less than 8 km/h, the predicted fallout area will be circular, the radii of two concentric circles around GZ being equal to the Zone I downwind distance and the Zone II downwind distance respectively.

A.3-12 The downwind distance of Zone I can be determined using the nomogram Figure A-X. Enter the nomogram with the yield and an effective downwind speed of 8 km/h.

A.3-13 Read the value of the Zone I downwind distance and multiply the distance by 2 to obtain the downwind distance of Zone II.

Annex 4, Appendix A

FALLOUT PREDICTION; SIMPLIFIED PROCEDURE

THE SIMPLIFIED PROCEDURE.

A.4-1 The simplified fallout prediction method requires nuclear burst information, a current NBC Effective Downwind Message (NBC EDM), and a simple template (radiological fallout predictor).

A.4-2 This procedure affords the subordinate commands direct and immediately usable means to estimate the fallout hazard with the least possible delay. Effective downwind speed and downwind direction for each of seven selected weapon yields are transmitted periodically to subordinate units by higher headquarters, in the form of the NBC EDM, to enable subordinate commanders to use the simplified procedure.

A.4-3 An NBC EDM can be produced at NBC Centers and meteorological centers from the NBC BWM (see Annex 3, Appendix A) or by use of standard pressure level winds (see Annex 3, Appendix A).

A.4-4 An NBC Effective Downwind Forecast (NBC EDF) is produced at designated meteorological centers from computer originated forecast winds. The NBC EDF is designed for planning purposes at NATO commands and higher national commands. It may be used at lower levels (NBC Collection or NBC Sub Collection Centers) only if actual wind data or NBC EDM are not available.

A.4-5 A simple template and estimated yield of a particular burst are all that is needed in addition to the NBC EDM/NBC EDF.

THE NBC EDM.

A.4-6 Since effective downwind speed and effective downwind direction vary with the yield, seven downwind speeds and downwind directions are transmitted, corresponding to seven preselected yield groups, ALFA through GOLF as follows:

ALFA is 2 KT or less
BRAVO is 2 KT to less than 5 KT
CHARLIE is 5 KT to less than 30 KT
DELTA is 30 KT to less than 100 KT
ECHO is 100 KT to less than 300 KT
FOXTROT is 300 KT to less than 1000 KT (1 MT)
GOLF is 1000 KT to less than 3000 KT (3 MT)

A.4-7 To calculate the data, use the procedure in Annex 3, Appendix A with 2 KT for ALFA, 5 KT for BRAVO, and 30 KT for CHARLIE and so on.

A.4-8 This data will be transmitted in the following basic format:

<u>NBC EDM</u>

NBCEVENT/EDM//
AREAM/RRRRR//
ZULUM/ddttttZMMMYYYY/ddttttZMMMYYYY/ddttttZMMMYYYY//
UNITM/LL/DDD/SSS/-//
ALFAM/-/ddd/sss/-//
BRAVOM/-/ddd/sss/-//
CHARLIEM/-/ddd/sss/-//
DELTAM/-/ddd/sss/-//
ECHOM/-/ddd/sss/-//
FOXTROTM/-/ddd/sss/-//
GOLFM/-/ddd/sss/-//

A.4-9 In the NBC EDM basic format, ZULUM ddttttZMMMYYYY is the date and time at which the real winds are measured (e.g. 250600Z is the 25th day of the month at 0600Z). LL/DDD/SSS/ are the units of measurement being used e.g. LL = km (KM), DDD = degrees true north (DGT) and SSS = knots (KTS). ddd is <u>effective downwind</u> direction in degrees, and sss effective downwind speed in knots (e.g. ALFA 080025 is a <u>downwind</u> direction of 080 degrees and 025 an effective downwind speed of 025 knots, valid for yields of 2 KT or less.

A.4-10 The format transmits data determined at the Collection Centre or lower level where the detailed fallout prediction procedure is used.

A.4-11 These data are transmitted to subordinate levels to permit use of the simplified procedure.

USE OF NBC EDM AND TEMPLATE.

A.4-12 From the NBC EDM determine the <u>downwind</u> direction for the specific yield group. Draw a line from the centre of the circles (GZ) on the template through the <u>downwind</u> direction in degrees on the template compass rose. Mark this line GN.

A.4-13 Use the nomogram on Figure A.6-X to determine the downwind distance of Zone I. The downwind distance of Zone II is the double of the Zone I downwind distance.

A.4-14 Draw arcs between the two radial lines, using GZ as centre and the Zone I and Zone II downwind distances as radii and draw the tangents from the specific yield group semicircle to the intersection points of the Zone I arc with the radial lines.

A.4-15 Using the effective downwind speed for the specific yield group, draw and label dotted lines within the warning area to indicate the estimated times of arrival of fallout.

A.4-16 Place the GZ of the template over the GZ on the map, and align the template GN with the map GN. The arcs, the radial lines and the yield group semicircle determine the extent of the warning area.

A.4-17 Some of the above listed details may be omitted from the template if such details are already available on the situation map.

Example:

A nuclear detonation has occurred, and based upon the observations taken, the yield has been estimated to be 35 KT and type of burst is surface burst.

The following NBC EDM is available:

NBC EDM

NBCEVENT/EDM//
AREAM/NFEA//
ZULUM/271100ZMAY1999/271200ZMAY1999/271800ZMAY1999//
UNITM/KM/DGT/KPH/-//
ALFAM/-/095/020//
BRAVOM/-/102/024//
CHARLIEM/-/115/028//
DELTAM/-/122/029//
ECHOM/-/126/029//
FOXTROTM/-/132/029//
GOLFM/-/140/035//

A.4-18 Based upon the information above, a fallout prediction, by use of the simplified procedure, can be prepared as follows:

a. Yield Group Determination: As 35 KT is between 30 KT and 100 KT, select yield group DELTAM from the NBC EDM.

b. The Grid North Line: As the downwind direction for yield group DELTAM of the NBC EDM is 122 degrees, draw the GN line from the centre of the yield semicircles through 122 degrees on the inverted compass rose (Figure A.4-III).

c. Zone I Downwind Distance Determination: Using the effective downwind speed of 29 KPH and the 35 KT yield, determine the downwind distance of Zone I from the nomogram Figure A-X to be 33 km. Therefore the Zone II downwind distance is 66 km. Draw the contour extension around GZ from DELTAM semicircle (using the 100 KT cloud radius) to the intersection of the Zone I arc with the radial lines. (See Figure A.4-III).

d. Estimated Times of Arrival of Fallout: Using the effective downwind speed of 29 KPH, indicate the times of arrival of fallout by dotted arcs at 29 km and 58 km downwind; label these lines H+1 and H+2 respectively. (See Figure A.4-III).

e. Complete the template: Label the template to indicate the scale, the estimated yield in KT, the date and time of attack, the location of the attack and the NBC EDM used for the prediction.

f. Use of the Template: Place GZ of the template over the GZ on the map, and align GN of the template with the map GN.

SPECIAL CASES.

a. Effective Downwind Speed less than 8 KPH (or 4.32 KTS): When the effective downwind speed is less than 8 KPH for a given yield group, the applicable line of the NBC EDM will contain only three digits, giving the downwind distance of Zone I. An effective downwind direction is not transmitted in the NBC EDM, since in this case the downwind distance of Zone I describes the Zone I as a circle around GZ. Zone II will then be within another circle around GZ, the radius of which is double the radius of the Zone I circle. In the NBC EDM in Figure A.4-I, the yield groups ALFAM and BRAVOM reflect only the downwind distance of Zone I in km. The downwind distance becomes the radius of a circle around GZ, describing Zone I. A second circle of twice the radius of Zone I will define Zone II.

NBC EDM
NBCEVENT/EDM//
AREAM/NFEA//
ZULUM/271100ZMAY1999/271200ZMAY1999/271800ZMAY1999//
UNITM/KM/DGT/KPH/-//
ALFAM/004//
BRAVOM/007//
CHARLIEM/-/210/014//
DELTAM/-/220/016//
ECHOM/-/225/020//
FOXTROTM/-/230/030//
GOLFM/-/240/035//

Figure A.4-I, Example NBC EDM Containing Special Cases on Wind Speed less than 8 KPH for sets ALFAM and BRAVOM.

b. Angle Expansion: The simplified procedure does not normally provide for a warning angle greater than 40 degrees. In the instances where the detailed procedure demands an angle greater than 40 degrees, this warning area angle is to be given in the NBC EDM to subordinate units to expand their original warning area.
In computer originated NBC EDM, the angle expansion will be shown in field 4 of each of the yield groups, as shown in the example below (Figure A.4-II). This means, that for yield groups FOXTROTM and GOLFM, the 40 degrees standard angle between the two radial lines must be expanded to 60 degrees, i.e. 30 degrees on each side of the reference line.
If the angle is greater than 120 degrees, the detailed procedure must be used to determine the exact angle.

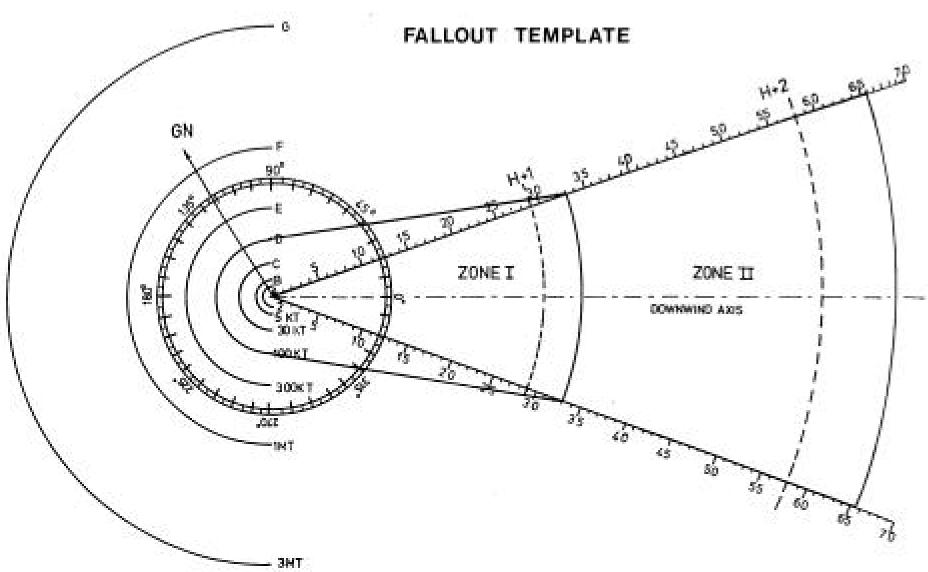
NBC EDM
NBCEVENT/EDM//
AREAM/NFEA//

ZULUM/271100ZMAY1999/271200ZMAY1999/271800ZMAY1999//
UNITM/KM/DGT/KPH/-//
ALFAM/004//
BRAVOM/007//
CHARLIEM/-/210/014/4//
DELTAM/-/220/016/4//
ECHOM/-/225/020/4//
FOXTROTM/-/230/030/6//
GOLFM/-/240/035/6//

Figure A.4-II, Example NBC EDM Indicating Special Cases.

Explanation of the 7th digit:

4 = 40 degree angle
5 = 50 degree angle
6 = 60 degree angle
7 = 70 degree angle
8 = 80 degree angle
9 = 90 degree angle
0 = 100 degree angle
1 = 110 degree angle
2 = 120 degree angle
3 = more than 120 degree angle.
(The detailed procedure must be used to determine the exact angle).



Scale: 1: 250 000
Estimated Yield: 35 KT
Date-time of Attack: 271220ZMAY1999
Location of Attack: 31UUB208196

NBC EDM: 271200Z

Figure A.4-III, Fallout Template with Fallout Prediction Plot.

ANNEX 5, APPENDIX A

RECORDING AND CALCULATION OF RADIOLOGICAL CONTAMINATION FROM A NUCLEAR BURST

LOCATING AND REPORTING RADIOLOGICAL CONTAMINATION.

A.5-1 Fallout predictions provide a means of locating probable radiation hazards (see annexes 1-4 to appendix A). Military significant fallout is expected to occur only within the predicted area. However, the prediction does not indicate exactly where the fallout will occur or what the dose rate will be at a specific location. Rainout or washout can also increase radiological contamination on the ground creating local hot spots. Areas of neutron induced radiation also can be caused by low air bursts.

A.5-2 Before planning operations in a nuclear environment, commanders must be aware of these residual contamination hazards. The information required for such planning is derived from the equations and nomograms given in the following sections and in AEP-45. The basic information needed is contained in NBC 4 NUC reports. They provide information on actual measured contamination in the form of dose rates.

AIRBORNE RADIOACTIVITY.

A.5-3 Most contaminated particles in a radioactive cloud rise to considerable heights. Thus, fallout may occur over a large area. It may also last for an extended period of time. A survey conducted before fallout is complete would be inaccurate, because contaminants would still be suspended in the air. For this reason, as well as the hazard to surveying personnel, radiological surveys are not conducted before completion of fallout.

A.5-4 An estimate of the time of completion (T_{comp}) of fallout for a particular location may be determined using a mathematical equation. The time in hours after burst when fallout will be completed at any specific point is approximately 1.25 times the time of arrival of fallout (in hours after burst). Add the time in hours required for the nuclear cloud to pass over.

A.5-5 This is expressed by using the formula:

$$T_{comp} = 1.25 \times T_{arrival} + \frac{2 \times Cloud\ radius}{Effective\ wind\ speed}$$

Example.

For a given location, the following data has been determined:

- Time of detonation = H
- Time of arrival = H+2 hours

  (Time of arrival is determined by dividing the distance from GZ to the given point by the effective wind speed)
- Cloud diameter = 4 km (equals 2 x cloud radius)

  (Cloud diameter/radius is determined from Figure A.5-III of Annex A or from set PAPAB of the NBC 3 NUC report)

- Effective wind speed = 20 KPH
(Effective wind speed is determined from set YANKEE of the NBC 3 NUC report)

$$T_{comp} = 1.25 \times 2h + \frac{4\,km}{20\,KPH} = 2.5h + 0.2h = 2.7h$$

Thus, fallout for the given location is expected to be complete by H + 2.7 hours.

A.5-6 Actual completion of fallout can be determined if a peak NBC 4 NUC report is received from the area of interest.

MEASURING RADIOLOGICAL DATA.

A.5-7 Measurements of radiological data must be taken in accordance with the unit's SOPs. Measurements can be taken directly from an unshielded position if dose rates are low enough, or from a shielded position such as a shelter or vehicle.

A.5-8 When the indirect technique is used, most of the readings are taken inside the vehicle or shelter. However, at least one outside reading is necessary to determine the transmission factor, which relates the readings inside to the unshielded values outside. The latter are to be reported since they are necessary for further calculations pertaining to troops in the open, or other vehicles, or shelters.

A.5-9 To determine the transmission factor both the inside and outside readings must be taken after fallout is complete. Calculate the transmission factor using the following formula:

$$\text{Transmission Factor } (TF) = \frac{\text{Inside dose rate}}{\text{Outside dose rate}}$$

NOTE: TF is always less than 1.
It can be determined from the measurement of the dose as well.

A.5-10 The readings taken inside the vehicle or shelter represent inside shielded dose rates (ID). These readings must be converted to outside, unshielded dose rates (OD) before reporting. Readings are converted using the following formula:

$$OD = ID/TF$$

A.5-11 A precalculated list of TF is contained in national manuals, an example of which is shown in Figure A.5-XVI of Annex A. This information is <u>not</u> used by the unit NBC defence personnel when calculating or reporting outside dose rates. Its principal use is to establish the relative shielding ability of one shelter, structure, or vehicle as compared to another. It is also used for instructional and practice purposes.

A.5-12 These factors are for the most exposed occupied location. They are not based on dose rates from fallout; they are based on gamma radiation from cobalt-60. Since cobalt-60 radiation is almost twice as strong as the radiation from fallout, actual TF should be much lower (more protection).

A.5-13 In some cases the term <u>protection factor (PF)</u> (or correlation factor (CF)) is used. It is always the reciprocal of the transmission factor.

$$PF\,(or\ CF) = \frac{1}{TF} = \frac{OD}{ID}$$

SURVEYS.

A.5-14 Air-Ground Correlation Factors (AGCF). AGCF is required for calculation of surface dose rates from aerial dose rates taken in an aircraft during a survey. The air ground correlation factor relates a ground dose rate reading to a reading taken at approximately the same time in an aircraft at survey height over the same point on the surface.

A.5-15 The AGCF is calculated as shown below:

AGCF = Ground dose rate / Aerial dose rate

Example:

Surface dose rate = 20 cGy/h

Aerial dose rate (200 feet survey height) = 5 cGy/h

AGCF = 20 cGy/h / 5 cGy/h

AGCF = 4

A.5-16 By multiplying the readings taken in the aircraft at a survey height by the AGCF, the surface level reading can be approximated. These values are to be reported in the NBC 4 NUC.

Ground dose rate = Air dose rate x AGCF

REPORTING INSTRUCTIONS.

A.5-17 Monitoring data to be sent to other units/HQ's is transmitted in the NBC 4 NUC report format (Chapter 5).

a. Automatic Reports.

In accordance with SOPs units in the contaminated area submit certain monitoring reports automatically. These provide the minimum essential information for warning, hazard evaluation, and survey planning. Reports are sent through specified channels to reach the NBC cell.

The automatic reports are the initial, peak, and special reports specified by the NBC center or required by commanders for operational purposes.

b. Initial Report.

After noting a dose rate of 1 or more cGy/h outside, defensive measures in accordance with SOPs are implemented, and the unit formats a NBC 4 NUC report containing the code "INIT" for initial in set ROMEO.

The first report is used at the NBC center to confirm the fallout prediction. The dose rate cannot be converted to H+1 at this time.

c. Peak Report.

After the initial contamination is detected the unit monitor continuously records dose rates according to the time intervals specified in unit SOPs. The dose rate rises until it reaches a peak, and then it decreases.

In some cases, the dose rate may fluctuate for a short time before beginning a constant decrease.

When the measurement continues to decrease, the monitor takes an inside reading and then an outside reading for the TF calculation. First, the inside reading is recorded. Within three minutes, the monitor goes to the outside location.

After all information is recorded, the NBC defence team calculates the TF and applies it to the highest dose rate. It then formats the NBC 4 NUC report. The word "PEAK" is used in set ROMEO.

d. Special Reports.

Other standing instructions may establish the requirement for special NBC 4 NUC reports. The NBC center evaluates these special reports. They invite command attention to areas or conditions of serious concern. The operational situation, unit radiation status, and similar considerations determine the criteria for these special reports, which cannot be specified here. Generally, this report may be required when the surface dose rate goes above a specified value. When the dose rate increases after showing continuous decrease, a special report must be sent. Special reports may be required after a specified period of time if the unit remains in the area.

e. Directed Reports.

Selected units in the contaminated area will be directed to submit additional NBC 4 NUC reports. The NBC center uses these reports to evaluate a radiological contamination hazard - the decay rate of fallout and how long this decay rate (and the contamination overlay) will remain valid. They are used to determine the H-hour (if unknown) and the soil type in neutron induced areas.

Reliable calculations are directly related to the precision of the dose rate measurement. Tactical decisions and personnel safety depend on the accuracy of these measurements. The assessment of further development of the contamination situation depends upon this data. An error in dose rate measurements means a similar error in all following calculations.

f. Series Reports.

A series report consis ts of a series of dose rate readings taken at the same location at time intervals specified in unit SOPs after the peak dose rate has been recorded. The location must remain constant. The report contains each reading and the time it was taken. The report contains the word SERIES in set GENTEXT.

g. Summary Reports.

The summary report shows the radiation distribution throughout units area of responsibility. The locations for the readings are selected by the unit according to the distribution of its elements and the extent or variety of the area’s terrain. The time each reading was taken is reported. The word SUMMARY is given in set GENTEXT.

h. Verification.

The verification report is a unit's response to a direct request. If data are lacking from a specific location near or in the unit's area the NBC center may request a verification report. It may also be requested to confirm abnormal readings reported earlier. A verification report is not a retransmission of the earlier report, but a check of the actual conditions of the area. The unit tasked with the submission of a verification report receives specific instructions as to the location from which a reading is desired. The word VERIFY is used in set GENTEXT to indicate a verification report.

REPORT FORMATTING INSTRUCTIONS AT THE NBC CENTER.

A.5-18 For the format used to pass monitoring and survey results see the NBC 4 NUC report as described in Chapter 5.

A.5-19 The format is as follows:

NBC 4 NUC

Set	Meaning
QUEBEC	**Location and type of reading/sample/detection.**
ROMEO	**Contamination level, dose rate trend, decay rate.**
SIERRA	**Date and time of reading or initial detection of contamination.**

A.5-20 The location is sent as UTM grid co-ordinates; the level of contamination reading is expressed in cGy/h.

A.5-21 Sets QUEBEC, ROMEO, and SIERRA may be repeated as many times as necessary to give a specific picture of the contamination throughout an area. A "zero" dose rate may also be reported on set ROMEO, and is an extremely valuable piece of information in determining the extent and duration of contamination.

A.5-22 Only outside dose rates are reported by the unit, and the date time group is reported in ZULU time. Certain abbreviations are associated with the dose rate to describe the circumstances surrounding the contamination. Note that the definition of set ROMEO includes information on the dose rate trend and the relative or actual radiation decay rate. The dose rate must be reported while the latter two items are optional. They require evaluation, which may be done above unit level. A monitor cannot provide this information.

A.5-23 Dose rate trends are:

INIT	**-**	**initial reading**
PEAK	**-**	**peak reading**
DECR	**-**	**decreasing since last reading**
INCR	**-**	**increasing since last reading**
SAME	**-**	**same**

A.5-24 Legal entries for the relative decay rate are: (see para A5-34 and A5-35)

DN	**-**	**decay normal**
DF	**-**	**decay faster than normal**
DS	**-**	**decay slower than normal**

Figure A.5-1 shows examples of NBC 4 NUC reports.

EVALUATION OF RADIOLOGICAL INFORMATION.

A.5-25 After NBC 4 NUC reports are available they must be evaluated with regard to the actual hazard encountered by troops in the contaminated area with the aim to predict expected dose rates and accumulated dosages for possible missions within the contaminated area. Theoretically, once a radiological hazard has been identified, the contamination existing at any future time can be calculated using simple decay relationships.

A.5-26 The dose rate at any location in a fallout area does not remain constant. It decreases with time according to the Kaufmann equation:

$$R_1 \times t_1^{\,n} = R_2 \times t_2^{\,n}$$

Which describes the decay of fallout after it has completely settled on the ground.

In this equation:

R	**is the dose rate at the location.**
t	**is the time in hours after H-hour.**
n	**is the decay rate.**

A.5-27 The subscripts ‘1’ and ‘2’ denote two separate dose rate measurements taken at the same location at different times.

A.5-28 Dose rate and total dose calculations cannot be performed until the decay rate is known. The true decay rate will not be known immediately. Accurate determination must wait until several sets of NBC 4 NUC reports are available.

A.5-29 The decay rate of fallout depends on many factors. Some of these factors are:

- Height and type of burst.
- Type of weapon (fission, fission-fusion, fission-fusion-fission).
- Type of active materials, as well as construction and structural materials within the weapon.
- Type and quantity of materials vaporised or sucked up into the fireball.
- "Salting" the weapon to produce a slow decay.
- When fallout overlaps fallout.
- Soil Type.

A.5-30 The decay rate varies with time. Generally, the decay rate becomes slower as time passes.

A.5-31 The same decay rate may not be present across the entire fallout pattern. The pattern as a whole will have an average value, which may vary from pattern to pattern. The amount of variation in the decay rate for fallout is expected to range from 0.2 to 2.0. The lower values are assumed for "salted" weapons.

A.5-32 Decay calculations are valid only if the dose rate readings are made after completion of fallout. While fallout is still arriving, the Kaufmann equation is not valid.

A.5-33 Because of the delay in determining the actual decay rate, an assumed decay rate of **n** = 1.2, referred to as standard decay, is used by all units until informed otherwise by the NBC center. When the actual decay rate has been established by the NBC center, it will be sent as set ROMEO on the NBC 4 or NBC 5 NUC report. The assumed normal decay rate of **n** = 1.2 is used in many simplified radiological calculation procedures. Optimum time of exit calculations are also based upon **n** = 1.2.

Note: In the equations of the following sections all times are given in hours after the burst. The information given in corresponding sets of the NBC messages (e.g. SIERRA) must be converted appropriately when moving from calculation to reporting or vice versa.

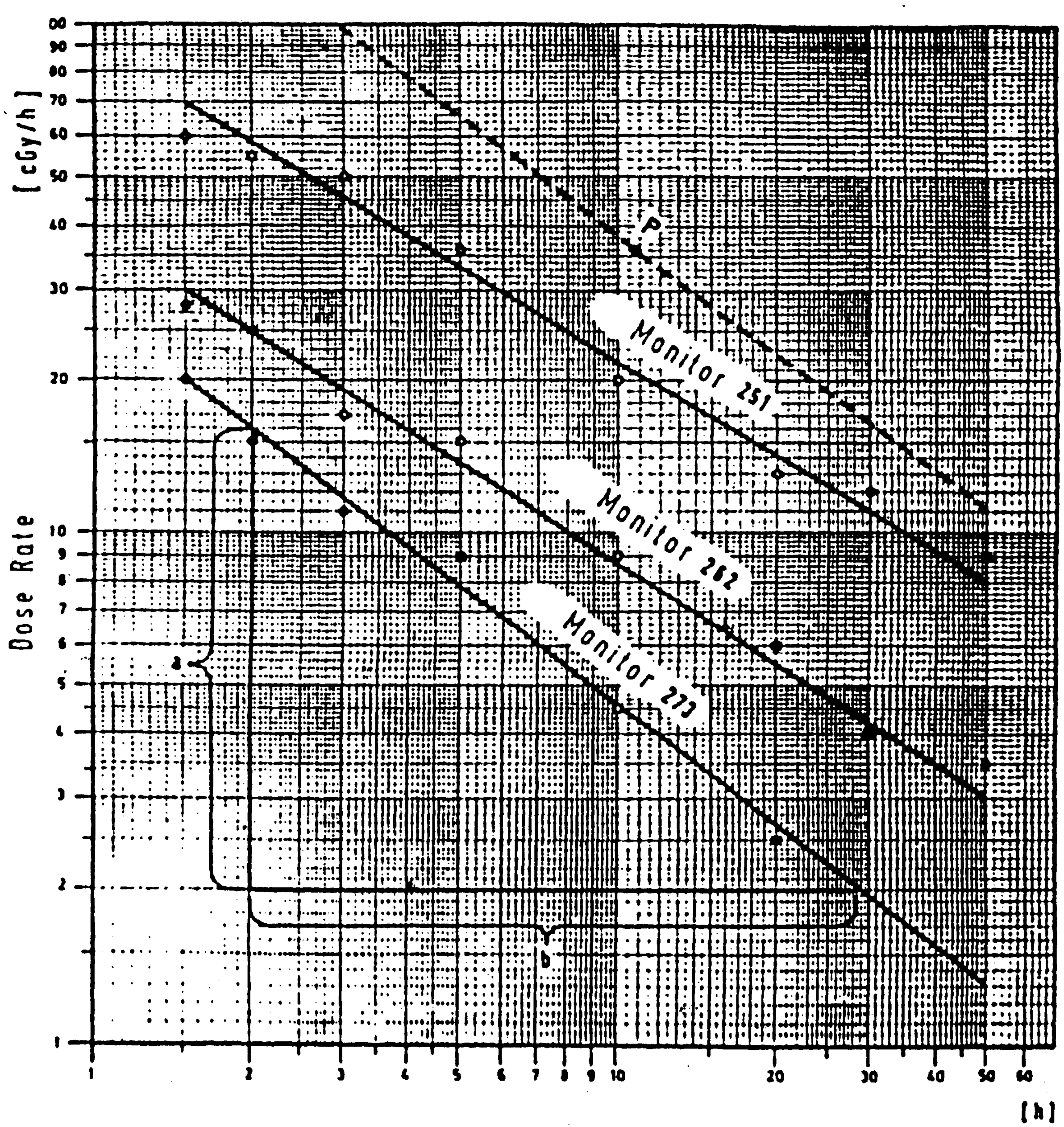
DETERMINATION OF DECAY RATE.

a. Mathematical Method (AEP-45, Annex D, Appendix D-19).

b. Graphical Method.

A.5-34 When a sequence of dose rates (NBC 4 NUC reports) from one location is plotted on log-log graph paper, the decay rate of the contamination will cause the line plotted to be a straight line, inclined at a slope (**n**) to the axes of the graph.

A.5-35 Figure A.5-II shows data plotted on log-log graph paper for 3 locations. The time is used as the number of hours past H-hour. A set of three lines is drawn through the points. The slope of the line is **n** = **a/b**, the decay exponent for each location. The best straight line is fitted to the points. The value of n may then be determined for each location and an average n determined for the area. If the slopes of the lines differ by more than 30 % from one location to the next, a mean value cannot be defined, and the decay rate determined for a given location can only be applied in the immediate vicinity of that location.



TIME (H-hour + NUMBER OF HOURS)

Figure A.5-II, Decay Rate Determination
(Measurement of Slope).

A.5-36 To predict the development of the decay at any other point **P** in the area, plot a reading from point **P** on the graph and draw a line with the slope of n through this point as shown at the top of the figure. In this way the dose rate at this point can be estimated for any time **H + t**.

A.5-37 Different graphical aids may be designed by nations or units to assist in determining the decay rate. An example for an overlay is given in Figure A.5-XVII of Annex A. To use it proceed as follows:

A.5-38 Plot the dose rate readings versus time as in Fig A.5-II.

A.5-39 Place the overlay on the Figure A.5nd move it up or down parallel to the grid until the points representing the measurements best fit one of the radial lines of the overlay. The label on the radial line indicates the decay rate.

CAUTION

When dealing with overlapping contamination areas, using an "average" **n** value for the overall pattern can lead to serious errors.

The reliability of the decay rate calculation depends on the precision of the dose rate readings, the interval over which the readings are taken, and the time over which dose calculations are to be made. That is, the more reliable the dose rate monitoring and the longer the time interval over which they are taken, the longer the time period over which reliable dose calculations can be made. As a rule of thumb, reliable dose calculations can be projected in time ($\mathbf{t_p}$) over a period up to three times as long as the monitoring time interval. For example, for a decay rate determined from monitoring readings taken between H+4 and H+8, dose calculations could be reliably projected from H+8 to H+20 ($\mathbf{t_p}$ = H+8 + 3 (* (8 - 4)) = H+20). Thus, the calculations based upon decay rate are valid for 20 hours after the burst. This information should be placed on the contamination overlay to advise the user of the length of time the calculations are valid.

DETERMINATION OF THE DOSE RATE FOR AN ARBITRARY TIME.

a. Mathematical Method (see AEP-45, Appendix D-19).

b. Graphical Method.
To determine the dose rate at an arbitrary time it is necessary to use a reference dose rate for the reference times H+1 and H+48.
The following equation is used for this purpose:

$$R_n = NF \times R_t$$

n is the normalised time, e.g. 1 or 48, and **t** is the time elapsed since the burst.

A.5-40 The normalising factors **NF** can be tabulated as shown in the Table in Figure A.5-XVIII of Annex A or presented graphically as shown in Figure A.5-XIX of Annex A. The dose rate at H+1 hours can also be determined by using one of the nomograms in Figure A.5-XX through A-XXXVIII of Annex A, given a dose rate reading at H+t.

A.5-41 When working with aerial or ground survey data, an additional step reduces the number of required calculations. Multiply the normalising factor either with the air-ground correlation factor

(**AGCF**) for aerial surveys or the vehicle correlation factor (**CF**) to determine the overall correction factor (**OCF**) before applying the correction to the measured data to normalise it to the reference time desired (e.g. when preparing reports).

DETERMINATION OF THE TIME AT WHICH A GIVEN DOSE RATE IS TO BE EXPECTED.

a. Mathematical Method (see AEP 45, Appendix D-19).

b. Graphical Method.
When the decay rate and the normalised dose rate for H+1 are known, the dose rate at H+t, or the time **t**, when a specific dose $\mathbf{R_t}$ will occur, can be read from the nomograms shown in Figures A-XX through A-XXXVIII of Annex A.

TOTAL DOSE REDUCTION.

A.5-42 The primary objective of the commander is to accomplish the mission while keeping the total dose as low as possible. The total dose may be reduced in several ways.

a. Avoid the area. When the actual measured fallout area cannot be avoided, select the route, which has the lowest dose rate. Commit the fewest number of personnel possible to the operation.

b. Reduce exposure time. Plan operations to minimise time spent in contaminated areas. Select the route easiest to cross. This route should offer high speed advance.

c. Delay time of entry. If possible, allow the contamination to decay, refer to the nomograms in Figure A.6-XX through A.6-XXXVIII of Annex 6 to Appendix A for details.

d. Use shielding. All vehicles should have increased shielding. Cross fallout areas on foot as a last resort.

TOTAL DOSE PROCEDURES.

a. Mathematical Method (see AEP-45, Appendix D-19).

b. Nomogram Method.

(1) Total dose, time of entry, and time of stay calculations in fallout areas may also be solved with total dose nomograms. These nomograms may be based on different anticipated decay rates. The respective nomograms are at Figure A.6-XXXIX through A.6-LVII of Annex 6 to Appendix A.

(2) Total dose nomograms relate total dose, H+1 dose rate, stay time $\mathbf{T_s}$, and entry time $\mathbf{T_e}$. The index scale is a pivoting line. It is used as an intermediate step

between **D** and $\mathbf{R_1}$, and $\mathbf{T_s}$ and $\mathbf{T_e}$. The index scale value can be used to multiply the $\mathbf{R_1}$ to find the **D**. The four values on these nomograms are defined below:

D = total dose in cGy.

$\mathbf{R_1}$ = dose rate in cGy/h one hour after burst (H+1).

The H+1 dose rate must **ALWAYS** be used. **NEVER** use a dose rate taken at any other time.

$\mathbf{T_s}$ = stay time in hours.

$\mathbf{T_e}$ = entry time (hours after H-hour).

$\mathbf{R_1}$ must be known before the total dose nomograms can be used. If any two of the other three values are known, the nomograms can be used to find the missing piece of information.

D and $\mathbf{R_1}$, or $\mathbf{T_s}$ and $\mathbf{T_e}$ are used together.

When working with total dose nomograms, start the problem on the side of the nomogram where the two known values are located. If **D** and $\mathbf{R_1}$ are given, start on the left side. If $\mathbf{T_s}$ and $\mathbf{T_e}$ are given, start on the right side. Never begin a problem by joining **D** or $\mathbf{R_1}$ with either of the time values.

(3) Example:

Given: $\mathbf{R_1}$ **= 200 cGy/h.**
$\mathbf{T_e}$ **= H + 1.5 hours.**
$\mathbf{T_s}$ **= 1 hour.**
n = 1.2

Find: D

Answer: 90 cGy.

Solution.

Select the **n** = 1.2 total dose nomogram. Connect H + 1.5 hours on the $\mathbf{T_e}$ scale with the $\mathbf{T_s}$ reading of 1 hour. Pivot the hairline at its point of intersection with the index scale to the 200 cGy/h on the $\mathbf{R_1}$ scale. Read **D** = 90 cGy on the total dose scale.

(4) By 25 hours after the burst, the change in the rate of decay is so low that it is relatively insignificant. Therefore, a different approach is used to estimate total dose when $\mathbf{T_e}$ is greater than 25 hours. In this case, simply multiply the dose rate at the time of entry by the time of stay. This is written:

$$D = R_{Te} * T_s$$

D = total dose (cGy).
$\mathbf{R_{Te}}$ **= dose rate (cGy/h) at time of entry.**
$\mathbf{T_s}$ **= time of stay (h).**

For example:

Given: $\mathbf{R_1}$ **= 300 cGy/h.**
$\mathbf{T_s}$ **= 2 hours.**
$\mathbf{T_e}$ **= H + 30 hours.**

n = 1.2

Find: D

Answer: **10 cGy.**

Solution.

Select the 1.2 decay rate nomogram. Align 300 cGy/h on the $\mathbf{R_1}$ scale with 30 hours on the $\mathbf{T_e}$ scale. Read the dose rate at the time of entry on the $\mathbf{R_t}$ scale (the $\mathbf{R_{Te}}$) as 5 cGy/h.

Find dose $D = R_{Te} * T_s$

5 cGy/h. * 2 hours

D = 10 cGy.

When $\mathbf{T_s}$ must be calculated against a dose limit, the above formula must be rearranged.

$$T_s = \frac{D}{R_{Te}}$$

Using the data from the previous problem, this is solved as:

$$T_S = \frac{D}{R_{Te}} = \frac{10}{5}$$

$$T_S = 2\,hours$$

Note that the dose rate at the time of entry is used here. Get the time of entry by determining the time the $\mathbf{R_1}$ value will decay to the $\mathbf{R_t}$ value.

Using the data from the two previous examples:

$$R_{Te} = \frac{D}{T_S} = \frac{10}{2}$$

$$R_{Te} = 5$$

Now determine when (time) 300 cGy/h will reduce to 5 cGy/h. Align the $\mathbf{R_1}$ value and the $\mathbf{R_t}$ value. Note that the hairline crosses the time (t) scale at H + 30 hours. Therefore, $\mathbf{T_e}$ = H + 30 hours.

CROSSING A FALLOUT AREA.

A.5-43 In nuclear warfare, it is to be expected that extensive areas will be residually radioactive. It may be necessary to cross an area where there is residual radiation.

A.5-44 When crossing a contaminated area, the dose rate will increase as the center of the Area is approached and will decrease as the far side is approached. Therefore, determine an average dose rate for total dose calculations. A reasonable approximation of the average dose rate can be determined using only one half of the highest dose rate. This is written:

$$R_{avg} = \frac{R_{max}}{2}$$

R_{avg} = average dose rate.

R_{max} = highest dose rate encountered or expected to be encountered.

A.5-45 This calculation is sufficient when looking for a suitable route for crossing a contaminated area or when time is critical. A more exact solution for this problem is given in AEP-45, Appendix D-19.

A.5-46 The effective dose rate for a crossing problem can be treated like the dose rate for a fixed point. Therefore all follow on calculations (e.g. accumulated dose, earliest time of entry) for the crossing problem can be done using the same procedures used for a fixed point described in the above.

A.5-47 The transmission factor must also be applied as in a stationary situation.

OPTIMUM TIME OF EXIT FROM FALLOUT AREAS.

A.5-48 Radiological fallout may present a serious hazard to units that remain in the contaminated area. Shelters such as field emplacements are the best protective measures against nuclear radiation for troops in the field. If the shelter provides any appreciable amount of protection, it will be advantageous to remain and improve it rather than to evacuate to an uncontaminated area. If the situation permits, and higher HQ's approve, the commander may decide to move out of the contaminated area. By evacuating at the optimum exit time, the radiation dose to personnel is kept to a minimum.

A.5-49 To compute the optimum exit time from a fallout area, you must know the time of detonation, the location of an uncontaminated area, the average **TF**, and the time required to evacuate.

A.5-50 When moving from an area contaminated by fallout, the unit moves into an uncontaminated location. This will necessitate waiting until fallout is complete at present positions.

A.5-51 The average **TF** of the fallout shelters and the vehicles used to leave the contaminated area must be computed. Since all shelters are not the same, an average value should be used. The **TF** of a vehicle may be estimated. A unit moving on foot will be fully exposed and will have a **TF** of 1.0.

A.5-52 The time to load vehicles and move out of the contaminated area must be estimated. In order to minimise exposure time, it may be necessary to temporarily abandon non essential items and recover them at a later time when the dose rate has decreased to an acceptable value.

A.5-53 The optimum time of exit ($\mathbf{T_{opt}}$) is calculated as:

$$T_{opt} = MF \times T_{ev}$$

where:

MF is a multiplication factor taken from Figure A.6-LVIII of Annex 6 of Appendix A.

T_{ev} is the time required to evacuate the contaminated area.

The following abbreviations are used in the optimum time of exit calculations:

T_{FS} = Average **TF** for the fallout shelters.

T_{FM} = Average **TF** after leaving shelters (during movement out of the contaminated area).

TF_{Ratio} = **TF** ratio.

Compute the optimum exit time by the three following steps:

- Calculate the **TF** ratio, $TF_{Ratio} = T_{FS}/T_{FM}$.
- Determine the multiplication factor. Enter the vertical axis of Figure A.6-LVIII of Annex 6 of Appendix A with the value obtained for TF_{Ratio}. Move horizontally along this value to the curve. Move straight down and read the multiplication factor from the horizontal axis.
- Calculate the optimum exit time. Multiply the multiplication factor by T_{ev}. The product is the optimum time, in hours after detonation, that the unit should leave its shelters and evacuates the area.

a. Special Considerations.

The unit should evacuate the fallout area as soon as possible when ratios of TF_{Ratio} are close to or greater than 0.5.

If the optimum time of exit is estimated to be before the actual arrival of fallout, the unit should evacuate the area as soon as possible after fallout is complete and an uncontaminated area is available.

The unit will receive the smallest dose possible if it leaves the contaminated area at the optimum time of exit. If the commander is willing to accept up to a ten percent increase in dose, he may leave the shelters any time between one half and twice the optimum time of exit.

If possible, personnel should improve their shelters while waiting for the optimum time of exit. The estimate of the optimum time of exit should be recalculated if significant improvement is made in the shelters. Improved shelters mean the unit should remain in shelters for a longer period of time to minimise the dose to the personnel.

Sample Problem.

Given: T_{FS} = **0.1 (foxhole).**

T_{FM} = **0.6 (2½ ton truck).**

T_{ev} = **1 hour.**

Find: Optimum time of exit.

Solution: TF_{Ratio} = **0.1/0.6 = 0.167**

Multiplication factor = 2.80

Optimum time of exit = MF * T_{ev} = 2.80 * 1 h

= 2.80 h

or 2 hours and 48 minutes.

INDUCED RADIATION.

A.5-54 Neutrons are produced in all nuclear weapon bursts. Some of these neutrons may be captured by the various elements in the soil under the burst. As a result, these elements become radioactive, emitting beta particles and gamma radiation for an extended period of time. Beta particles are a negligible hazard unless the radioactive material makes direct contact with the skin for an extended period of time. Beta particles can cause skin irritations varying from reddening to open sores. In contrast, gamma radiation readily penetrates the body and can cause radiation injury and even death. To determine the external military hazard posed by induced radiation, an analysis of the dose rate of the emitted gamma radiation must be determined.

A.5-55 The location of a suspected induced radiation area created by an air burst is determined by nuclear burst data. Weather conditions have no influence upon its location or size. Surface winds will not affect the pattern. The pattern, if produced, will always be around GZ. The size of the pattern depends on the yield of the weapon and height of burst. Figure A.5-III shows the boundaries of the induced area for different yields. Assuming an optimum height of burst, the user enters the table with the yield of the weapon (or interpolates if not listed). The distance given is the maximum horizontal radius to which a 2 cGy/h dose rate will extend one hour after burst.

Estimated Yield (KT)	2 cGy/h dose rate at H + 1 hour Horizontal Radius (meters)
0.1	200
1	700
10	1000
100	1600
1000	2000

Figure A.5-III, Radii of Induced Contamination.

A.5-56 The circular area with a radius as given in Figure A.5-III around GZ is regarded as contaminated until actual dose rate readings indicate otherwise. The actual area of contamination is usually substantially less, depending upon actual yield and height of burst.

DECAY OF INDUCED RADIATION.

A.5-57 The soil in the target area is radioactive to a depth of 0.5 metres at GZ. In contrast, fallout is a deposit of radioactive dust on the surface. From this it can be seen that decontamination of the area is impractical.

A.5-58 The decay characteristics of induced radiation are considerably different from those of fallout. Fallout is a mixture of many substances, all with different rates of decay. Induced radiation is produced primarily in aluminium, manganese, and sodium.

A.5-59 Other elements, such as silicon, emit so little gamma radiation or decay so fast that they are less important.

A.5-60 During the first 30 minutes after a burst, the principal contributor to induced radiation is radioactive aluminium. Almost all soils contain aluminium. It is one of the most abundant elements in the earth’s surface. Radioactive aluminium has a half-life of two to three seconds. Because of this, almost all the radioactive aluminium has decayed within 30 minutes after the burst.

A.5-61 Most soils also contain significant quantities of manganese. This element decays with a half-life of about 2.6 hours. From 30 minutes after burst until 10 to 20 hours after the burst, both manganese and sodium are the principal contributors to the radiation. After 10 to 20 hours after the burst, sodium, which decays with a half-life of about 15 hours, is the principal source of radiation.

A.5-62 Soil composition is the most important factor in the decay of induced radiation. Its decay must be considered differently from that of fallout. For fallout, the decay rate is calculated by using the Kaufmann equation. For induced radiation, the percentage, by weight, of elements present in the soil determines the decay rate.

A.5-63 Since soil composition varies widely, even in a localised area, you must know the actual chemical composition of the soil to determine the rate of decay of induced radiation. The soils are divided into four types. Figure A.5-IV has been extracted from Defense Nuclear Agency Effects Manual 1 (DNA EM-1).

A.5-64 Since the actual soil composition will not be known, soil type II, the slowest decay, is used for all calculations until the NBC Center advises use of a different soil type.

	Chemical Composition of Soils			
Element	**Type I (Liberia, Africa)**	**Type II (Nevada Desert)**	**Type III (Lava, Clay, Hawaii)**	**Type IV (Beach, Sand, Pensacola, Florida)**
Sodium	**-**	**1.30**	**0.16**	**0.001**
Manganese	**0.008**	**0.01**	**2.94**	**-**
Aluminium	**2.89**	**6.70**	**18.79**	**0.006**
Iron	**3.75**	**2.20**	**10.64**	**0.005**
Silicon	**33.10**	**32.00**	**10.23**	**46.65**
Titanium	**0.39**	**0.27**	**1.26**	**0.004**
Calcium	**0.08**	**2.40**	**0.45**	**-**
Potassium	**-**	**2.70**	**0.88**	**-**
Hydrogen	**0.39**	**0.70**	**0.94**	**0.001**
Boron	**-**	**-**	**-**	**0.001**
Nitrogen	**0.065**	**-**	**0.26**	**-**
Sulphur	**0.07**	**0.03**	**0.26**	**-**
Magnesium	**0.05**	**0.60**	**0.34**	**-**
Chromium	**-**	**-**	**0.04**	**-**
Phosphorus	**0.008**	**0.04**	**0.13**	**-**
Carbon	**3.87**	**-**	**9.36**	**-**

Oxygen	**50.33**	**50.82**	**43.32**	**53.332**

Figure A.5-IV, Soil Types for Induced Radiation Calculations.

A.5-65 Soil type is determined by using engineer soil maps or a NBC 4 report and the induced decay nomograms. The method is basically a process of elimination. The dose rate and the time it was measured are applied to an induced decay nomogram. This will result in an H+1 or $\mathbf{R_1}$ dose rate. Then if the other dose rates and times from the series report result in the same $\mathbf{R_1}$ dose rate, that is the soil type. If not, check the other nomograms until the one used results in the same $\mathbf{R_1}$.

DOSE RATE CALCULATIONS.

A.5-66 The decrease in the dose rate must be calculated before total dose can be found. This is done with decay nomograms. Use the residual radiation (induced) decay nomograms in (Figures A.6-LIX through A.6-LXII of Annex 6 to Appendix A) for these calculations. They allow the user to predict the dose rate at any time after the burst. Each nomogram denotes time (hours) after the burst for one of the four soil types.

A.5-67 In each nomogram, the $\mathbf{R_1}$ scale is at the right. This scale shows H+1 dose rates. The $\mathbf{R_t}$ scale is on the left. This scale shows dose rates at times **t**.

Example.

Given: R_t = 150 cGy/h at H + 3 hours, soil type II.

Find: R_1

Answer: 190 cGy/h.

Solution:

A.5-68 Select nomogram for soil type II. Align the hairline with the 3 hour tick mark on the time (middle) scale (**t**) and the 150 cGy/h point on the $\mathbf{R_t}$ scale. Read the dose rate as 190 cGy/h at the point of intersection with the $\mathbf{R_1}$ scale.

TOTAL DOSE CALCULATIONS.

A.5-69 The nomogram in Figure A.6-LXIII of Annex 6 to Appendix A is used for predicting the total dose received in an induced area. This nomogram relates total dose, H + 1 dose rate, stay time, and entry time. The two scales to the left of the index line show total dose and H + 1 dose rate. There are two stay time scales to the right of the index line. The extreme right scale shows entry time. The index line is a pivoting line, which is used as an intermediate step between **D** and $\mathbf{R_1}$. $\mathbf{R_1}$ is found by using one of the induced decay nomograms. If soil type is unknown, assume the soil is type II. The total dose nomogram, Figure A.6-LXIII of Annex 6 to Appendix A, is **NEVER** used to find $\mathbf{R_1}$.

A.5-70 On Figure A.6-LXIII of Annex 6 to Appendix A, soil types II and IV under "stay time" will be used for total dose calculations if the soil type is not known. If the soil type is known, the appropriate scale under "stay time" will be used. It is possible to find any one value on the total dose nomogram if the other three are given, as illustrated in the following examples.

Example 1.

Given: **R_1 = 140 cGy/h.**
T_e = H + 6 hours.
T_s = 1 hour.

Soil type: **II**

Find: **D**

Answer: **72 cGy.**

Solution.
On nomogram at Figure A.6-LXIII of Annex 6 to Appendix A, connect H + 6 on the $\mathbf{T_e}$ scale with 1 hour on the $\mathbf{T_s}$ scale (soil types II and IV) with a hairline. Pin the hairline at the point of intersection with the index scale. Now pivot the hairline to 140 cGy/h on the $\mathbf{R_1}$ scale. Read 72 cGy on the **D** scale.

Example 2.

Given: **R_1 = 300 cGy/h.**
T_e = H + 6 hours.
D = 70 cGy.

Soil Type: **III**

Find: **T_s**

Answer: **1 hour.**

Solution.
On nomogram at Figure A.6-LXIII of Annex 6 to Appendix A, connect 70 cGy on the **D** scale with 300 cGy/h on the $\mathbf{R_1}$ scale. Pin the hairline at the point of intersection with the index scale. Pivot the hairline to H + 6 hours on the $\mathbf{T_e}$ scale. Read 1 hour on the $\mathbf{T_s}$ scale (soil types I and III).

TRANSMISSION FACTORS.

A.5-71 TF for induced areas are determined in the field. The **TF** in Figure A.6-XVI of Annex 6 to Appendix A should be used with the greatest reservation. Actual **TF** in induced areas may be lower by as much as 70 percent because of a very technical characteristic of radiation.

A.5-72 Essentially the strength of gamma radiation is measured in million electron volts (MeV). Fallout less than 24 hours old has an average energy of 0.67 MeV. Induced radiation emitted from the three principal soil elements has a range of 0.68 MeV to 1.2 MeV.

A.5-73 Because of the unique decay characteristics of induced radiation, **TF** must be recalculated frequently. Every four hours is recommended. This accounts for changes in the penetration ability of the remaining radiation.

CROSSING AN INDUCED RADIATION AREA.

A.5-74 If an area must be crossed, the lowest dose rate area, consistent with the mission, is selected.

A.5-75 In calculating total dose, it is necessary to determine an average dose rate; dose rates increase as the center of the area is approached and then decrease beyond the center of the area. The average dose rate represents a mean value the individual is exposed to during the time of stay. A reasonable approximation of the average dose rate can be obtained by dividing by two the maximum dose rate predicted to be encountered. This is written as:

$$R_{avg} = \frac{R_{\max}}{2}$$

Time of stay (stay time) must be calculated for crossing problems. Use the relationship of:

$$T_S = \frac{distance}{speed}$$

Then follow the same procedures as for fallout.

PLOTTING DATA AND PRODUCING A NBC 5 NUC MESSAGE.

A.5-76 Contaminated areas are shown on the radiological situation map, and information about them must be passed to other units and HQ's. The most expeditious means for this is the radiological contamination overlay.

A.5-77 The preparation of such an overlay is described below:

A.5-78 After all available information from monitoring and surveying has been plotted on a map as normalised (H+1) and corrected (unshielded ground dose rates) data contour lines for standard dose rates can be drawn on a radiological contamination overlay.

A.5-79 When constructing the radiological contamination overlay, there are factors that locally affect the contamination pattern.

A.5-80 This is particularly true between points in an aerial survey. These include topographic features such as bluffs or cuts, heavily built-up or wooded areas, and bodies of water. For example, a large river will carry away any fallout landing on it, leaving its path relatively free of contamination. Also, the contamination hazard near a lake will be lower than expected. The fallout particles will sink to the bottom of the lake, and the water will provide shielding. In wooded areas or built-up areas, a measure of the reduction of dose rate can be obtained by using the **TF's** (see Figure A.6-XVI of Annex 6 to Appendix A) for these areas.

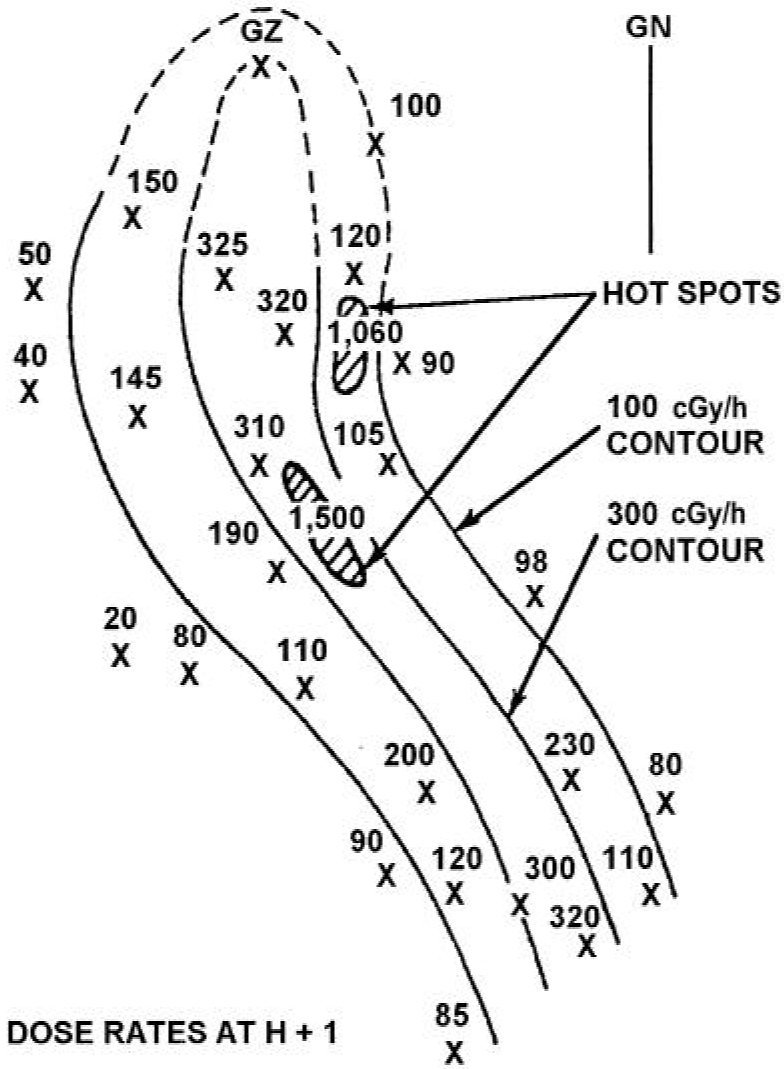
A.5-81 Dose-rate contour lines showing the contamination hazard in an area can be drawn as follows:

- Determine the H+1 dose-rate contour lines to be plotted (for example, 30, 100, 300, 1,000 centigray per hour). These contour lines may be required for NBC 5 purposes or for anticipated calculations to be made from the data.

- Determine the points on the chosen survey routes, or on course legs, and close to monitoring locations that are providing the desired dose rates. Interpolate linearly between dose rates as required.
- Connect all the points having the same dose rates with a smooth line. Use all plotted monitoring data as additional guides in constructing these contours.

A.5-82 The plotter must use care and judgement in plotting these contours and must visualise the probable general shape and direction of the pattern. Any dose rates disproportionately higher than other readings in the immediate area indicate possible hot spots. When such readings are reported, that area should be rechecked. If dose rates are confirmed, these hot spots should be plotted and clearly identified.

Figure A.5-V shows a typical plot, which might be developed, from survey data.



Legend:

Actual

Predicted

Figure A.5-V, Fallout Pattern plotted from Survey Data.

A.5-83 Radiological contamination overlays used for evaluation purposes must provide the most detailed information possible.

A.5-84 The minimum information required is:

- Map designation and orientation data.
- Nuclear burst and GZ identification (sets ALFA and FOXTROT of NBC 2).
- H-hour (set DELTA of NBC 2).
- Reference time (set OSCAR of NBC 5).

- Decay rate/soil type.
- Time of preparation and validity time.
- Source of the contamination fallout or neutron induced contamination.
- Standard dose rate contour lines.

A.5-85 Additional information such as time of completion lines for fallout may also be included where unit SOPs require such information.

REPORTING DATA.

A.5-86 Electronic communications are not always available. If this is the case, the radiological contamination overlay must be converted into a series of readings and co-ordinates for transmission as a NBC 5 NUC report. This method has a disadvantage. It requires the addressee to replot data from the NBC 5 NUC report and connect them to produce dose rate contours; a time consuming process. Staff planners must consider that the shapes of dose rate contours drawn to correspond with a relatively brief series of readings and co-ordinates can vary significantly.

A.5-87 If electronic communications of data or communications of hard copy are not available and if time and distance permit, radiological contamination overlays are sent by messenger. Data is transmitted, manually by the NBC 5 NUC report as a last resort.

A.5-88 When the contamination comes from a single burst, the dose rates will be normalised to H + 1. But if there have been several detonations at different times and no single H + 1 is possible, then the dose rates are reported for a specific time.

A.5-89 On the NBC 5 NUC report a closed contour line on a plot, is represented by repeating the first coordinate.

A.5-90 To calculate the dose rates along the contour lines at a later time use the procedures described in para A.5-40, and label the contour lines accordingly. AEP-45 describes methods by which contour lines may be produced using computers.

Appendix B

Chemical/Biological Tactics, Techniques and Procedures

Source Through NBC Center Level
Chemical and Biological Operations Checklist

This appendix provides a series of operational situations that outline contamination avoidance tactics, techniques, and procedures (TTP). The various situations are designed to assist commanders and chemical staff personnel in tactical operations. The TTPs included are not designed to replace any other listing of collective tasks, but is intended to be an operational contamination avoidance checklist. These checklists are not all-inclusive and may be adapted or modified for local use.

SECTION I – PREPARE FOR OPERATIONS IN A CHEM/BIO ENVIRONMENT

B-1. The following specifics apply –

a. Enemy is capable of offensive chemical or biological weapons employment.
b. Unit is provided intelligence on enemy NBC capabilities and likely COAs.
c. NBC threat status (chemical or biological) is Serial 2 or higher (the adversary has an offensive NBC capability, has received training in defense and employment techniques, but there is no indication of the use of NBC weapons in the immediate future. This indication may be based on whether NBC munitions are dispersed or deployed, or the stated objectives and intent of opposing forces).

Source Level Actions

B-2. Ensure authorized unit detection and individual protective equipment is on hand, operational, and issued per unit SOP.

B-3. Commanders perform MOPP analysis, Medical Treatment Facility based on METT-TC(Mission, Enemy, Terrain,) and higher headquarters guidance.

B-4. Update immunizations and enforce field sanitation measures.

B-5. Provide appropriate prophylaxis to servicemember.

B-6. Practice OPSEC, dispersion, cover and concealment.

B-7. Receive and correctly interpret periodic Chemical Downwind Message (CDM).

B-8. Adopt NBC contamination avoidance measures such as covering supplies and equipment with NBC Protective Covers (PC).

NBCC Actions

B-9. Oversee subordinate unit actions.

B-10. Prepare CDM report and send to subordinate units.

B-11. Ensure contamination avoidance measures are initiated around the headquarters complex IAW SOP.

B-12. Ensure chemical defense equipment (CE) shortages are placed on order and contingency stocks are serviceable and deployed IAW SOP.

SECTION II – PREPARE FOR A CHEMICAL OR BIOLOGICAL ATTACK

B-13. The following specifics apply:

a. The enemy has or is likely to employ chemical or biological weapons.
b. Chemical/biological weapons employment is considered to be a likely course of enemy action.

Source Level Actions

B-14. Subordinate units are alerted.

B-15. Commander(s) specify appropriate MOPP levels; establish automatic masking criteria; and, if MOPP 0 is assumed, determine the location for chemical protective clothing and Medical Treatment Facility based on METT-TC.

B-16. Unit continues the mission while implementing actions to minimize casualties and damage.

- Personnel, equipment, munitions POL, food, and water are protected from contamination.
- Detection paper is placed to provide visibility and maximum exposure to liquid agents.
- OPSEC, dispersion, cover and concealment are practiced so the unit may avoid being targeted.
- Chemical/biological detectors, samplers, and alarms are checked and prepared for use.
- Ensure units have update CDM on hand.
- Chemical Agent Alarms, biological samplers, LP/OP, and air guards are employed as required and /or the tactical situation permits.

NBCC Level Actions

B-17. Alert subordinate units and elements of the Task Force.

B-18. Monitor the unit's MOPP status.

B-19. Ensure subordinate units have taken measures out lined by unit SOP.

B-20. Ensure subordinate units have received the most current CDM.

B-21. Plan for possible decon support, establish decon priorities, locate hasty and possible detailed decon sites, and coordinate with the Chemcal Company supporting.

B-22. Ensure biological agent samplers are prepared for operation.

SECTION III – RESPOND TO A CHEMICAL OR BIOLOGICAL ATTACK

B-23. The following specifics apply:

B-24. a. Subordinate unit or units is (are) subjected to a chemical or biological agent attack.

Source Level Actions

B-25. All personnel automatically mask, sound alarm, decontaminate themselves as required, assume MOPP 4, and administer self-aid and buddy-aid.

B-26. Restore the Chain of Command and communications, and continue themission.

B-27. In the event of a biological attack, unit collects samples with a Biological Agent Sampling Kit.

B-28. Warn adjacent units immediately of the potential downwind vapor hazards.

B-29. Unit identifies type of agent and submits an NBC 1 Chemical or Suspected Biological Report as the mission permits.

B-30. For attacks that leave liquid or solid contamination on equipment, personnel, or terrain, the unit performs the following:

- Conducts personal wipe down and operator spray down.
- Wraps and marks KIAs.
- Marks contaminated area and relocates to a clean area if the mission allows.
- Determines where and when further decon can be accomplished if necessary.
- Coordinates for decon support and resupply of protective clothing and decontaminants.
- Ensures contaminated protective overgarments are exchanged within 24 hours after being contaminated.

B-31. For nonpersistent agents, the unit performs the following:

- Conducts unmasking procedures.
- Treats casualties and prepares for evacuation as the mission permits.
- Services detection systems to ensure operational status.

B-32. Receive NBC 2 Report, plot potential hazard area, and inform the commander.

NBCC Level Actions

B-33. Receive NBC 1 Reports and pass them to subordinate, adjacent, and higher units.

B-34. Consolidate NBC 1 Reports and prepare the NBC 2 Report. Post the NBC 2 Report to the situation map and pass it to subordinate, adjacent, and higher-units.

B-35. Request NBC 1 (Follow-up) Report if needed to identify the agent.

B-36. Prepare and disseminate the NBC 3 Report and disseminate it to subordinate/slice units.

B-37. Evaluate subordinate unit damage assessment. If required, provide assistance to the unit in reestablishing command and control.

B-38. If attack is determined to be a biological attack, assist in the identification of the agent if possible.

B-39. Determine decontamination requirements based on METT-TC, extent of contamination, and the availability of assets.

B-40. If decontamination is required and METT-TC conditions permit, prepare a decontamination request IAW SOP and sent it to the supporting chemical unit. If the chemical unit is not available, the request is forwarded to higher headquarters.

B-41. Order items to replace contingency stocks.

Source Level Actions

B-42. The following specifics apply:

a. Unit or elements of the task force have been subjected to a chemical or biological attack.

B-43. Conduct decontamination operations and evacuate casualties.

B-44. Reorder CDE equipment

B-45. Identify whether attack was chemical or biological using the following equipment:

B-46. Chemical Agent Monitor (ICAM).

- Biological Agent Sampling Kits. Samples are forwarded to higher HQ for lab analysis.
- M256A1 Kit.

B-47. If the units must continue to operate in or occupy the contaminated area, the unit should perform the following:

- Continue efforts to refine the contamination hazard area and extent by continued sampling/detection.
- Adjust MOPP as required.
- Mark contaminated areas and identify "hot spots".
- Monitor contamination decay to determine when natural decay may render the area safe.
- Be alert for "transient contamination", the spreading or movement of contamination by natural sources (e.g., wind, rain, runoff, rivers…etc) or by human sources, (e.g., vehicle traffic, rotorwash… etc).

NBCC Actions

B-48. Ensure attacked unit has completed necessary decon measures and evacuates casualties.

B-49. Receive report from lab on agent analysis. Inform higher headquarters of results.

B-50. Ensure attacked unit reorders CDE to replace that which was used.

B-51. Request decontamination support for attacked units as required..

B-52. Continue to refine the limits and extent of the contaminated area and inform the commander on the effects of contamination on future operations.

B-53. Monitor natural decay of agent. Be alert to conditions which may cover or move contamination to previously clean areas. This may occur through natural sources (e.g., wind, water… etc).

- Take periodic soil samples with the Biological Sampling Kit and forward to higher HQ for analysis.
- Monitor terrain with M8/M9 paper, ICAM, or M256A1 kit for chemical contamination.
- Be prepared to advise commander on when the agent is expected to decay to a safe level.

SECTION IV- OPERATE IN A CHEM/BIO CONTAMINATED AREA

B-54. The following specifics apply:

- Unit must remain in contaminated area.

Source Level Actions

B-55. Unit continues the mission.

B-56. Using NBC 1 or 2 Report from higher HQ or an adjacent HQ, the unit prepares a downwind vapor hazard prediction. The commander is advised of estimated cloud arrival time, and subordinate units are notified.

B-57. Chemical agent alarms are employed per unit SOP if the situation permits it or an LP/OP is used.

B-58. When an NBC Report is received, plot it to update previous estimates.

B-59. Commanders perform a MOPP analysis to determine level of protection required.

B-60. Unit reacts to the arrival of the downwind vapor hazard and at a minimum assumes a "Mask Only" posture.

B-61. Commander conducts unmasking procedures if appropriate, and adjusts protection as appropriate by using MOPP analysis.

NBCC Actions

B-62. Units receive warning from higher or adjacent units in the form of an NBC 2 or NBC 3 Report of an NBC 1 Report from subordinate or adjacent units.

B-63. Prepares a downwind vapor hazard prediction and determine the effects. The units within or close to the predicted area are alerted to the possible downwind hazard.

B-64. If and when a unit is within the downwind hazard area, it follows steps outlined in responding to a chemical/biological attack in paragraph 1-24..

B-65. Advise the Task Force Commander of the estimated cloud arrival time, chemical agent, extent of downwind vapor hazard, and an estimation of the duration of the contamination.

B-66. Provide advice to the commander on courses of action and MOPP level.

B-67. Send commander's guidance to subordinate units.

B-68. Direct subordinate units to emplace alarms, biological samplers, and other detection equipment IAW SOP.

B-69. Ensure subordinate units are complying with the commander's guidance. Direct that subordinate units report the arrival of the agent cloud at their location.

SECTION V – RESPOND TO A CHEM/BIO CONTAMINATED AREA

B-70. The following specifics apply:

a. Unit must remain in a contaminated area.

Source Level Actions

B-71. Unit continues the mission.

B-72. Commander specifies MOPP level needed to provide required protection and adjusts work rates and activity to prevent MOPP heat stress.

NOTE: *Unless positive identification is made to determine whether the attack was a chemical or biological agent, the unit should remain in MOPP4 for a minimum of 4 hours.*

B-73. Commander estimates the duration of contamination and the time or stay within the contaminated area and, as required, initiates actions to maintain unit effectiveness.

- Buddy system is employed to watch for symptoms of chemical agents, to monitor stress from heat and encapsulation, and to administer immediate first aid.
- Water consumption is supervised to ensure every servicemember consumes 1 quart every 3 hours (every 2 hours if the temperature is above 80 degrees F).
- Clean areas, or collective protection areas are located where servicemember can be rotated to eat and rest.
- Arrangements are made for MOPP gear exchange if contaminated servicemembers must stay in MOPP for over 24 hours.

B-74. Contamination avoidance and hasty decon techniques are used to minimize the spread of contamination.

NBCC Level Actions

B-75. Unit continues the mission.

B-76. Ensure subordinate units continue to monitor area for duration of the hazard.

B-77. Ensure subordinate units continue to practice contamination avoidance procedures IAW SOP.

B-78. Ensure CDE is reordered when required.

B-79. Coordinate with higher headquarters for decontamination support.

SECTION VI – CROSS A CHEM/BIO CONTAMINATED AREA

B-80. The following specifics apply:

a. Subordinate units must cross an area contaminated with persistent chemical or biological agents.
b. The unit is moving and the reconnaissance teams discover that the area which the unit must cross is contaminated.

Source Actions

B-81. NBC Report and/or contamination overlay is posted to the situation map. Unit conducts or requests surveys of different routes if time permits.

B-82. Commander uses available information to determine the best route based on contamination avoidance principles and mission requirements. Advance party/advance guard/point has chemical detection supplies and equipment to test for contamination and downwind vapor hazards along the route. They report contaminated areas unless otherwise directed by the commander.

B-83. NOTE: If the unit possesses or has access to an NBC Recon System (NBCRS), this vehicle should be used with the advance party.

B-84. Personnel and equipment are prepared for crossing by:

- Increasing MOPP as required.
- Ensuring M9 Paper is placed on clothing and equipment.
- Ensuring chemical alarms are serviced and mounted on vehicles or carried by personnel IAW SOP.
- Ensuring M11 decon apparatus and /or M13 DAPS are serviced, filled and mounted on vehicles.
- Ensuring M256A1 Detector Kits are issued to operators.

B-85. Unit crosses the contaminated area using contamination avoidance techniques.

B-86. After exiting the area, unit performs hasty decon provided that the mission is not jeopardized (commander's decision).

NBCC Actions

B-87. Obtains current SITREPS from the unit crossing the contaminated areas. Ensures this information is passed to all units that might be affected.

B-88. Post the NBC 5 Report to the situation map to aid the commander in selecting the appropriate route for crossing.

B-89. Notify the crossing unit(s) of decontamination assets available and hasty or detailed decontamination site(s) to be utilized after crossing.

B-90. If internal decontamination support is not available additional decontamination support will be required, request through higher HQ.

B-91. Ensure that crossing unit receives contingency stocks of CDE, and the unit is prepared to cross the area IAW SOP.

B-92. Crossing unit executes contamination avoidance techniques IAW SOP.

B-93. After crossing the area, ensure crossing unit(s) request decon support IAW SOP.

B-94. Notify higher HQs that the crossing is completed, the number of casualties sustained (if any), and the decontamination support requirements and/or degree of decon operations scheduled.

B-95. Ensure that the subordinate unit reports the completion of decontamination operations to higher HQs.

SECTION VII – CONDUCT A CHEMICAL OR BIOLOGICAL SURVEY

B-96. The following specifics apply:

- A downwind hazard prediction indicates chemical or biological agents may affect the units' operational area.
- Areas of interest within the units' operation area may be contaminated with a chemical or biological agent.
- Higher headquarters directs unit to conduct a chemical/biological survey in the unit's area of operation.
- The tactical situation requires the unit to conduct a chemical/biological survey.

Source Level Actions

B-97. Unit initiates or is given an area to be surveyed, plans the survey, and organizes the party. The briefing includes but is not limited to the following:

- Type of survey and/or techniques to be employed.
- Reporting requirements.
- Marking requirements.
- Special preparation of vehicles to enhance contamination avoidance.

B-98. Survey teams(s) execute(s) mission as directed.

B-99. NBC Defense Team submits evaluated data to higher headquarters.

B-100. Unit decontaminates as required.

NBCC Level Actions

B-101. NBCC receives the mission request and/or determines the area to be surveyed. Requests NBC reconnaissance vehicle support.

B-102. Ensures subordinate unit initiates, conducts, and reports survey data IAW the guidance from the requesting headquarters SOP.

B-103. Requests decontamination support for survey party IAW SOP.

B-104. Identifys potential decontamination sites (if required).

B-105. Ensures subordinate unit reports the start time of the survey, significant findings, and completion time of the survey.

B-106. Ensures subordinate unit submits NBC 4 Reports as required by the SOP. Receives, logs-in, checks for accuracy, and forwards the report to higher headquarters. The NBCC keeps a copy of this report.

B-107. Posts survey findings on the situation overlay IAW SOP.

SECTION VIII – CONDUCT DECONTAMINATION OPERATIONS

B-108. The following specifics apply:

a. Subordinate unit(s) report contamination from a persistent chemical or biological agent.
b. Personal wipe down has been completed but personnel are still contaminated.

Source Level Actions

B-109. Unit determines the number of contaminated personnel and the extent of equipment contamination.

B-110. Unit requests decon support and coordinates for chemical protective clothing replacement.

B-111. Unit designates decon team, moves to the assembly area which is downwind from the decon site, links up with chemical company's decon unit, and receives a briefing on the decon site operation.

B-112. Unit conducts detailed decon at designated decon site

B-113. Unit completes reconstitution and resumes or awaits the next mission.

NBCC Level Actions

B-114. Subordinate unit requests decontamination IAW SOP.

B-115. The commander is briefed on the type and extent of contamination, how long the contaminated unit can stay in the current posture without further decontamination, and the availability of decontamination support.

B-116. The commander decides if the unit will initiate decontamination operations. The decision is based on METT-TC.

a. If the decision is made not to decontaminate, the unit is provided guidance on protective measures to continue to take.
b. If the decision is to decontaminate, the following support is provided:
   (1) Decontamination support is requested from the supporting chemical unit if decon assets are not organic to the organization.
   (2) The subordinate unit is (are) notified of the decision and the location of the linkup point for the decontamination site.
   (3) Higher headquarters notifies the contaminated unit and ensures that their unit deploys the decon team to prepare the site. The unit decontamination team will operate the decon site. If this support is not available, the unit's decon team will operate the site utilizing organic decontamination assets, e.g., M13 DAP and /or M11. The unit decon team establishes entry and exit traffic control.

B-117. Subordinate units will be given the time for moving to the decon site, moving into the predecon staging area, and rendezvous point based on the route and type of march to and from the site, etc.

B-118. The contaminated unit reports arrival at the decon site, completion of 50% of the unit, and completion of decon operations to the higher headquarters.

B-119. Completion of the decon operations and site closure is reported to the appropriate headquarters.

B-120. Subordinate unit reorders contingency stocks of CDE that were expended during decontamination.

SECTION IX – EVACUATE CHEM/BIO CONTAMINATED CASUALTIES

B-121. The following specifics apply:

- Unit has sustained casualties that are chemically or biologically contaminated.

Source Level Actions

B-122. Unit requests medical evacuation based on normal considerations of medical care required, urgency, and the tactical situation. Evacuation requests will be made IAW SOP.

B-123. Unit informs higher HQs on number of casualties sustained, type of contamination, and mode of evacuation.

B-124. Casualties are brought to MEDEVAC aircraft or vehicle. Unit will take measures to limit the spread of contamination.

B-125. Casualty is marked with type of contamination and first aid is given.

NBCC Level Actions

B-126. Subordinate unit informs higher HQ on the number of casualties, type and time of contamination and method of evacuation desired.

B-127. Notify the subordinate unit that had been designated to provide a detail for patient decon support. Ensure subordinate unit is provided with the time for the detail to report, location of medical treatment facility, and POC at the medical treatment facility.

B-128. Notify medical treatment facility of incoming casualties. Medical treatment facility must plan for detail to assist with patient decontamination.

B-129. Notify higher HQs on the number of casualties, type of contamination, and estimated time of arrival (ETA) to the medical treatment facility.

B-130. Notify the supporting chemical unit or higher HQs about the possibility for decontamination support either for the MEDEVAC helicopter or ground ambulance.

B-131. Ensure that the medical treatment facility coordinates for decontamination (if required).

B-132. Inform the medical treatment facility when to have the ambulance or helicopter report to the decontamination site, from what direction to approach the decon site, and point of contact at the site.

B-133. Ensure that the ambulance or MEDEVAC helicopter is decontaminated IAW SOP.

SECTION X – RESPOND TO AN UNEXPECTED CONTAMINATED AREA

B-134. The following specifics apply:

- Advance party or reconnaissance team did not detect contaminated area.
- NBC 5 Report did not accurately depict the boundaries of the contaminated area.
- Enemy forces executed attack after reconnaissance was completed.
- Maneuver elements or unit enters contaminated area unexpectedly.

Source Actions

B-135. After the unit recognizes that it is in a contaminated area, members perform the following tasks:

- All elements halt.
- Service members don protective equipment (MOPP suit, mask… etc).
- Each service member performs personal wipe-down if required.
- Chemical casualties are identified and treated.
- Alerts other units and HQ that contamination has been found.

- If the unit is in direct-fire contact, continue the mission and fight dirty. If not, proceed with remaining steps.
- Using the M256A1 Kit or other detection devices, check immediate area for type and amount of contamination.

B-136. Any element in a contaminated area will continue forward checking area every 500 meters.

B-137. Based on METT-TC, the unit commander will determine which direction the unit should move to exit and bypass the contaminated area.

B-138. The first “clean” element, based on the commanders assessment, will move 500 meters to the rear to establish the initial rear side line. Then the element will:

- Turn 90 degrees (left or right) and move 500 meters.
- Halt, and check for contamination.
- If contamination is found, turn 90 degrees and move 500 meters to the rear.
- Check for contamination. If no contamination is found, turn 90 degrees in the original direction of travel and move 500 meters. Check area again for contamination.

B-139. Element finding the initial far side line, or bypass route, should clearly mark the route using either:

- NBC Marking Kit
- Colored Smoke.
- Guides.

B-140. Once the unit has safely traversed contaminated area it shoul do the following:

- Report coordinates of bypass route to higher and adjacent units.
- Report casualties and request medical extraction, if required.
- If time and mission permits, conduct vehicle wash-down and MOPP gear exchange
- Request decontamination support from higher HQ at earliest possible time.
- Continue mission.

NBCC Actions

B-141. Receive initial report from the maneuver element and:

- Plot coordinates on situation map.
- Prepare NBC 4 Contact Report and sent to higher and adjacent units.
- Provide any guidance and/or assistance to maneuver elements.
- Inform commander and/or S3 of situation.
- Monitor progress of maneuver element until element has safely crossed the area.

B-142. Report coordinates of bypass route to higher.

B-143. Inform commander and/or S3 of the bypass route, and status of maneuver element.

B-144. Coordinate for :

- Decontamination support, at earliest possible time.
- Replenishment of chemical defense equipment (CDE) for the maneuver element.
- Plan further reconnaissance of contaminated area if necessary.

SECTION XI – RESPOND TO CIVILIAN CHEMICAL ACCIDENT OR INCIDENT

B-145. The following specifics apply:

a. Enemy operatives, agents or an attack has created damage to civilian chemical or biological facilities or production plant(s).

b. Tactical operations have caused the unexpected or unintentional release of chemical or biological materials (solid, liquid, or gas) into the environment.

Source Actions

B-146. Alert higher, adjacent and lower units.

B-147. Immediately secure the area and perform the following tasks :

- Start continuous monitoring using the M256A1 Kit or similar detection device. Ensure results are reported using NBC 4 Chemical Report format.
- Assume MOPP 4.
- Establish security zone around the area of no less than 620 meters radius. This area may be enlarged depending on chemical agent involved.
- Evacuate casualties from security zone. Casualties should be considered as contaminated and should be contained in one central location. Initiate emergency decontamination of personnel.
- Identify witnesses for questioning.
- Establish a 10km downwind hazard zone from the perimeter of the security zone.
- All personnel within this zone must don MOPP 4 or evacuate the area until further notice.

B-148. Maintain security until released by HQ.

NBCC Actions

B-149. Alert higher, adjacent, and lower units.

B-150. Ensure security and downwind hazard zones are established and that the following actions are taken :

- Casualties are evacuated.
- Request assistance from: Military Police ,Medical personnel, EOD teams (if required), Host Nation support, DoD response teams.
- Use technical reachback capabilities to obtain technical information from subject

B-151. If hazard is in vapor form plot a Case TIM (Appendix C). Ensure friendly units and civilians in the predicted downwind hazard area are warned. If the hazard is in a liquid form, with no evaporation hazard present, the 620 meter security zone should be adequate.

B-152. Maintain security of the area.

Annex 1, Appendix B

BIOLOGICAL ATTACKS, PREDICTION AND WARNING OF ASSOCIATED HAZARDS AND HAZARD AREAS

The biological prediction procedure provides information on the location and the extent of the hazard area and the duration of the hazard resulting from attacks with biological weapons.It provides the necessary information for commanders to warn units within the predicted hazard area.

Biological agents (BIO) include a variety of micro-organisms and a variety of toxic molecules (TOX) derived from micro-organisms, plants and animals.

SECTION I – DEFINITIONS

B.1-1. ATTACK AREA. This is the predicted area immediately affected by the delivered biological agent.

B.1-2. HAZARD AREA. This is the predicted area in which unprotected personnel may be affected by agent spreading downwind from the ATTACK AREA. The downwind distance depends on the type of attack and on the weather and terrain in both the ATTACK AREA and the area downwind of the ATTACK AREA.

B.1-3. CONTAMINATED AREA. This is the area in which some BIO hazard may, in solid or liquid form, remain at hazardous levels for some time after the attack. The actual shape and duration can only be determined by surveys.

SECTION I I – GENERAL

B.1-4. The prediction of the attack and hazard area is dependent upon:

- The type of delivery (and agent container),
- The type of attack, and
- The meteorological factors.

SECTION III – DELIVERY MEANS

B.1-5. The means of delivery and the type of agent container are listed below:

Delivery System Type

AIR	Aircraft
BOM	Bomb
CAN	Cannon
MLR	Multiple Launched Rocket System
MSL	Missile
MOR	Mortar
PLT	Plant
RLD	Railroad Car
SHP	Ship
TPT	Transport
TRK	Truck or Car
UNK	Unknown

Agent Container Type.

BML	Bomblets
BOM	Bomb
BTL	Pressurised Gas Bottle
BUK	Bunker
CON	Generic Storage Container
DRM	Nominal 200 litre Storage Drum
GEN	Aerosol Generator
MSL	Missile
RCT	Reactor
RKT	Rocket
SHL	Shell
SPR	Spray (tank)
STK	Stockpile
TNK	Storage Tank
TOR	Torpedo
MNE	Mine
UNK	Unknown
WST	Waste

SECTION IV – TYPES OF ATTACK

B.1-6. Attacks can be divided into 4 types:

a. **Type “P”**:
Type P consists of attacks with localised exploding munitions such as: bomb (BOM), shell (SHL), Rocket (RKT), mine (MNE), pressurised gas bottle (BTL) and surface burst missile (MSL).

b. **Type “Q”**:
Type Q consists of attacks with munitions that cover a large area such as: bomblets (BML), air burst MSL, surface release spray (SPR) or aerosol generator (GEN).

c. **Type “R”**:
Type R consists of attacks where the location of the attack is known, but the type of container unknown (UNK), or the attack was from an air release SPR or GEN.

d. **Type “S”**:
Type S consists of detection after an unobserved attack.

SECTION V – METEOROLOGICAL FACTORS

B.1-7. Influence of Weather on the Effectiveness of Biological Agents

(1) Temperature. Temperature is not expected to have any significant effect on the hazard area resulting from a biological attack.

(2) Air Stability Category. The air stability category describes the degree of mixing of a released agent with the air in the lower atmosphere. There are three general air stability categories:

(a) **Stable**. Under stable conditions there is little mixing and thus higher concentrations, and the agent cloud will be effective over long distances.

(b) **Neutral.** Under neutral conditions the intermediate range is most common.

(c) **Unstable.** Under unstable conditions there is strong mixing and thus shorter hazard distances.

(3) Wind. The wind speed and direction will affect the spread of biological clouds.

(4) Humidity and Precipitation. Humidity and precipitation will alter the effects of biological agents in different ways. Very low humidity will decrease the effectiveness by increasing the rate at which agents dry out from atmospheric exposure. Heavy or continuous rain will locally reduce biological contamination by washing it out of the air.

(5) Inversion Layers. In most cases the concentration of the biological agent will decrease with increasing height and reach a low concentration at approximately 800 metres altitude. Normally there will be no risk above 3000 metres above ground. Certain meteorological conditions in the atmosphere, known as inversion layers are associated with stable conditions specified in the NBC CDR under the term "stability category". Stable conditions usually

occur at night or in the morning under conditions of clear skies and low wind speed but will also result any time the ground or water surface is cooler than the air above it. An elevated inversion layer occurs when the surface inversion layer decays. With both inversion and elevated inversion layers the concentration of the biological agent will be higher within the layer than with no inversion. The concentration of the biological agent will be very small above the layer. If the height of the top of any inversion layer is lower than 800 metres, this will be indicated in the NBC CDR by the letter "**A**" appearing in the coded "significant weather phenomena". If the height of the top is lower than 400 metres, letter "**B**" is to be used, if lower than 200 metres, letter "**C**". These letters signify the lowest safe altitudes for aircraft to avoid being biologically contaminated.

(6) Sunlight and Air Exposure. Most biological agents will lose their viability or toxicity with time after exposure to the atmosphere. Most biological agents will have a greater rate of loss of viability or toxicity when exposed to bright sunlight.

B.1-8. Influence of Terrain on the Effectiveness of Biological Agents.

The path and speed of a biological cloud is considerably influenced by the nature of the terrain in the downwind area. Biological clouds can flow over rolling terrain and down valleys. Dangerous concentrations may persist in hollows, depressions and trenches. The BIO clouds tend to go over or around obstacles such as hills, but tend to be retarded by rough ground, tall grass and bushes. Flat terrain allows for an even, steady movement.

B.1-9. Meteorological Definitions.

(1) Downwind Direction:
The mean surface downwind direction towards which, the biological cloud travels in the hazard area. The optimal measuring height should be 10 m above the ground in an open terrain averaged over a period of 10 minutes.

(2) Downwind Speed:
The mean surface downwind speed in the hazard area. The optimal measuring height should be 10 m above the ground in open terrain averaged over a period of 10 minutes.

(3) Air Stability Category:
The stability category is normally reported in the NBC CDR. If it must be determined locally use Annex 2 to Appendix B.

SECTION VI – NBC CHEMICAL DOWNWIND MESSAGE (NBC CDM)

B.1-10. The meteorological data required for the biological downwind hazard prediction procedure is contained in the NBC Chemical Downwind Message (NBC CDM).

B.1-11. The NBC CDM is transmitted at least 4 times a day, and each message is valid for a 6 hours period. Each 6 hours period is subdivided into three 2 hours periods. The NBC CDM can be sent down as far as source level.

B.1-12. If the observation time in the NBC CDM is before the time of validity, this NBC CDM contains evaluated weather data for the future up to 6 hours ahead.

B.1-13. If the observation time is later than one or more of the 2 hours periods of validity, the message contains measured data during the actual time period(s) of validity. Both types of NBC CDM contents will be used for biological hazard prediction.

B.1-14. The NBC CDM contains the following information:

(1) Area of validity.

(2) Date-time groups for time of observation, time valid from and time valid to.

(3) Units of measurement.

(4) Downwind direction and downwind speed.

(5) Air stability category.

(6) Surface air temperature.

(7) Relative Humidity.

(8) Significant weather phenomena.

(9) Cloud coverage.

B.1-15. In some cases local weather information, can be used for prediction.

Forecast, Evaluated Weather, and Measured Weather in NBC CDMs.

(1) When the values are given in a NBC Chemical Downwind Forecast (NBC CDF), they will represent forecasted (more than 6 hours ahead) average values for the given NBC CDM area in each given 2 hour period.

(2) When the values are given in a NBC CDM, they will represent evaluated (for the next 6 hours) average values for the given NBC CDM area in each given 2 hour period.

(3) In some cases, the observation time in a NBC CDM, is stated as being later than one or more of the periods of validity. In such cases, the values will represent actual measurements for the given NBC CDM area in each 2 hour period(s) where the observation time is later than the period of validity.

(4) The NBC CDM and NBC CDF can be obtained in a data format, the NBC Chemical Downwind Report (NBC CDR). The detailed computer generated format for the NBC CDR is explained below:

NBC Chemical Downwind Report (NBC CDR)

Common Message Heading followed by:

(M) **AREAM** (Area of Validity)

(M) **ZULUM** (Period of Validity)

(M) **UNITM** (Units of Measurement)

(M) **WHISKEYM** (Surface Weather for the first two hour Period)

(O) **XRAYM** (Surface Weather for the second two hour Period)

(O) **YANKEEM** (Surface Weather for the third two hour Period)

(5) Sample content of a computer generated NBC CDM:

AREAM/NDEL1//
ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//
UNITM/-/DGT/KPH/C//
WHISKEYM/070/022/6/15/-/-/1//
XRAYM/075/025/4/13/9/6/2//
YANKEEM/080/028/4/12/8/-/2//

Meteorological Requirements.

B.1-16. It is the task of a NBC Center to predict biological hazard areas for biological clouds. For this purpose the NBC Center must have the necessary meteorological information. National and/or NATO directives must ensure the provision of applicable NBC CDRs, and national or local SOPs must list directives for the observation and dissemination of local weather information. For more accurate biological hazard estimates, a record of actual local meteorological conditions should be maintained and disseminated.

Procedures.

(1) Record and update the following information:

- Weather information from relevant NBC CDRs, which may contain both forecast data and measured data.
- Weather information from local measurements and observations, which may contain both data before and during the cloud passage period.
- A data base of local meteorology measured during the cloud passage period.

(2) Record terrain features (wooded areas, mountains, plains, etc.) which may influence the direction and speed of biological agent clouds.

(3) A NBC 3 BIO may be generated and considered for distribution whenever a biological attack has taken place. If biological detection equipment is available this report will most likely be generated from one or more NBC 1, 2 or 4 BIO. Otherwise, this report will most likely be generated from one or more NBC 1, 2 or 4 CHEM, where the chemical agent is unknown.

(4) Estimate the meteorological parameters for the attack area and the predicted downwind hazard area, on receipt of a NBC 1 or NBC 2 BIO with agent UNK, BIO or TOX, or a NBC 4 BIO with agent BIO or TOX.

(5) Select, in accordance with national directives, the weather information to be used, and calculate the predicted downwind hazard area.

Constraints.

(1) When calculating the predicted downwind hazard area from biological attacks, many factors will affect the accuracy of the prediction. Some of these factors are: Type of and amount of biological agent(s); Type of and amount of delivery system(s); Type and amount of agent container(s); Terrain composition; Weather (rain, clouds, etc.); Air stability; Type of surface(s); Vegetation(s); Surface air temperature; Relative humidity, and changes to these factors.

(2) Some of these factors are not considered when using the procedures in this chapter, unless evaluated and estimated manually by the operator.

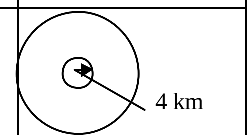
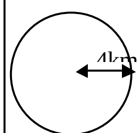
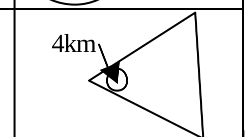
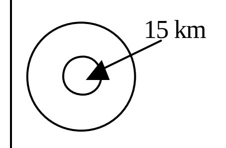
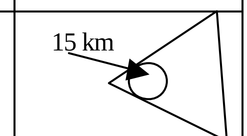
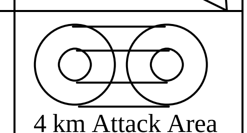
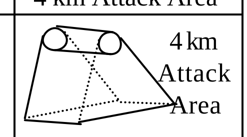
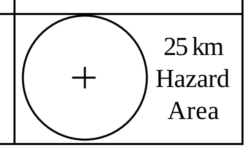
(3) The procedure shown in this chapter is based on the

limited amount of information available at the time of attack.

(4) To be able to make more accurate predictions, more information about the listed factors has to be available, and more sophisticated methods have to be used for prediction. Such procedures are described in ATP-45, Appendices D-12 and D-14.

SECTION VII – BIOLOGICAL HAZARDS

Types and Cases of Biological Attacks. (NOT TO SCALE)

TYPE OF AGENT CONTAINER	RADIUS OF ATTACK AREA *	LINEAR ATTACK AREA	WIND SPEED	TYPE **	CASE	FIGURE
BOM, RKT, SHL, MNE, Surface Burst MSL	£ 4 km		£ 10 KPH	P	1	
			> 10 KPH		2	
BML, Air Burst MSL, Surface release SPR, GEN	£ 15 km		£ 10 KPH	Q	1	
			> 10 KPH		2	
Air release SPR and GEN, UNK			£ 10 KPH	R	1	
			> 10 KPH		2	
Detection after unobserved attack (NBC 4 BIO message only)	£ 25 km			S	1 / 2	

***	A different observed radius may be specified in GENTEXT.**

****	If two types of attack are found, use the following order to determine which type of attack to use: Type "R", Type "Q", or Type "P".**

Biological Hazard Areas.

B.1-17. Biological agents (BIO or TOX) will create initial hazard areas similar in appearance to those for chemical attacks (para B.2-23). The initial hazard area for a biological line source will also be similar to that for a chemical line source (paras. B.2-24.e. and B.2-24.f.).

B.1-18. Computations for the biological hazard area for changes in meteorological conditions for all types are similar to the recalculation procedures provided in para B.2-25 for chemical attacks. However, biological agents will generally remain toxic through multiple changes in meteorological conditions and multiple NBC CDMs. Therefore, the recalculation procedures must be performed more than once. The procedures in this chapter are to be used for hazard estimation over both land and water.

Attack Areas.

B.1-19. The attack area for type "**P**" is drawn as a circle of radius 4 km., centered at the release location.

B.1-20. The attack area for Type "**Q**" is drawn as a circle of radius 15 km., centered at the release location.

B.1-21. The attack area for Type "**R**" is defined by the line end points entered as two positions in set FOXTROT. A 4 km. radius circle is drawn at the center position, or at the two end positions, with tangents connecting the two circles together. If the flight direction cannot be established, assume it to be perpendicular to the wind direction.

B.1-22. In case of only one position reported in set FOXTROT, the line is 50km long centered on this point and oriented in the direction of the aircraft trajectory centered at the middle of the observed flight path.

B.1-23. The attack area for Type "**S**" is drawn as a circle of radius 25 km, centered at the detection location. The attack area is unknown; this is only an initial area.

B.1-24. The attack area for Types "**P**", "**Q**" or "**R**" may be reduced or enlarged based on available information specified in GENTEXT. In computer generated messages this information will be formatted as: RDS:XXXKM, always using three digits for the radius, e.g. RDS:045KM.

Downwind Travel Distances for the Initial Period.

B.1-25. The downwind travel distance is defined as the distance travelled by the center of the cloud. The downwind travel distance is broken into three segments corresponding to the next time periods of the NBC CDR:

$$\mathbf{d_1 = u_1 t_1}$$

$$\mathbf{d_2 = 2u_2}$$

$$\mathbf{d_3 = 2u_3}$$

d_1 = distance in km travelled within the NBC CDR 2 hour period containing the attack.

d_2 = distance in km travelled within the next NBC CDR 2 hour period.

d_3 = distance in km travelled within the third NBC CDR 2 hour period.

u_1 = wind speed in KPH for the NBC CDR 2 hour period containing the attack.

u_2 = wind speed in KPH for the next NBC CDR 2 hour period.

u_3 = wind speed in KPH for the third NBC CDR 2 hour period.

t_1 = hours remaining after the attack or detection within the NBC CDR 2 hour period of validity corresponding to the attack.

B.1-26. For any NBC CDR time periods where the wind speed is less than 10 KPH, a value of 10 KPH should be used for computations.

B.1-27. Weather information may not be available for the full 6 hour period after an attack. If this is the case, the hazard distances can only be calculated for the time weather is available.

(1) If the attack or detection occurs in the first NBC CDR time period, 3 downwind distances are calculated; $\mathbf{d_1}$ using the first NBC CDR time period, $\mathbf{d_2}$ using the second NBC CDR time period, and $\mathbf{d_3}$ using the third NBC CDR time period.

(2) If the attack or detection occurs in the second NBC CDR time period, 2 downwind distances are calculated; $\mathbf{d_1}$ using the NBC CDR time during the period of attack/detection, $\mathbf{d_2}$ using the third NBC CDR time period.

(3) If the attack or detection occurs in the third NBC CDR time period, only $\mathbf{d_1}$ can be calculated.

B.1-28. The total downwind distance (**DA**) of the center of the bio cloud is the sum of the three distances:

$$\mathbf{DA = d_1 + d_2 + d_3}$$

DA = total downwind distance in km.

B.1-29. The leading and trailing edges for the current NBC CDR should also be computed based on the downwind distance path, using factors of 1.5 and 0.5, respectively:

$$\mathbf{DL = 1.5DA}$$

DT = 0.5DA
DL = leading edge distance in km.
DT = trailing edge distance in km.

B.1-30. For plotting the hazard area for the current NBC CDR, the third time period must be extended to include the leading edge:

DE = DL - d_1 - d_2
DE = extended distance in km travelled within the third NBC CDR 2 hour period.

SECTION VIII – PREDICTION OF BIOLOGICAL HAZARD AREAS

Initial Hazard Areas.

B.1-31. Case "**1**" attacks.

(1) The wind speed is 10 KPH or less, so a wind speed of 10 KPH should be used.

(2) The radius of the hazard area circle equals the attack area radius plus the product of a wind speed of 10 KPH, times the time in hours remaining after the attack of detection in the corresponding CDR time period. For example a Type "P", Case "1" attack having a 2 hour travel duration, the hazard area radius equals 24 km (2 x 10 + 4).

(3) A single hazard area circle will result for Types "**P**", "**Q**" and "**S**". The area within this circle represents the hazard area.

(4) Two circles are drawn for Type "**R**" with tangents drawn between the hazard area circles. The total enclosed area represents the hazard area.

(5) A value of zero is used for the downwind distance path, leading edge, and trailing edge computations for Case "**1**" attacks, since the wind direction is considered variable. The leading edge can be considered to be the edge of the hazard area circle.

B.1-32. Case "**2**" attacks "P", "Q" and "R" types.

(1) Draw a line through the center of the attack circle oriented in the downwind direction. For a Type "**R**" release pick one of the attack area circles. The line

should extend distance $\mathbf{d_1}$ in the downwind direction from the center of the circle. In the upwind direction along the same line mark a distance equal to twice the attack circle radius.

(2) Draw a line perpendicular to the downwind direction line at the downwind distance ($\mathbf{d_1}$) extending in both directions.

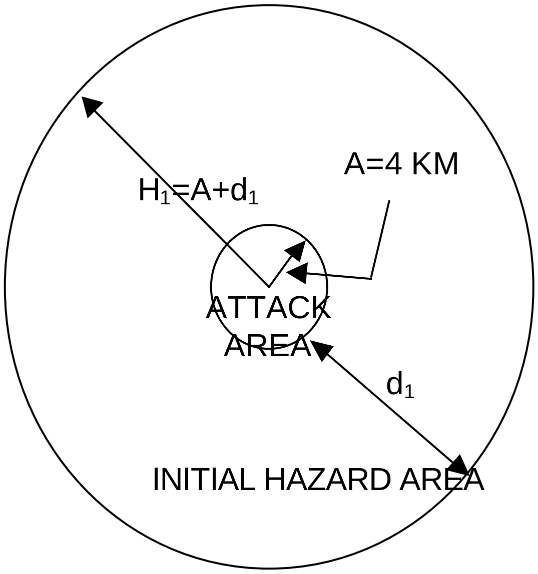
(3) Draw two tangent lines to the attack circle from the upwind point marked extending until they intersect with the perpendicular line. These lines will form a 30 degree angle on either side of the downwind direction line.

(4) For a Type "**R**" release repeat this procedure for the other attack area circle, and connect the lower hazard area corners to enclose the combined downwind hazard area.

(5) For a Type "**S**" release, there is no hazard area plotted because the location and time of the release are unknown. A circle of 25 km radius defines an area where there is a risk of being exposed to the biological agent. Informing friendly units throughout the area of this risk should be considered. Before a hazard prediction can be carried out, reports are required from units in the area or survey teams can be sent out. Once more information about the attack has been obtained, type "S" attacks should then be treated as either type "P", "Q" or "R".

Prediction of the Initial Hazard.

a. Type "P", Case "1".



A = radius of attack area
H_1 = radius of initial hazard area
d_1 = downwind travel distance in the CDR time period
t_1 = time remaining from attack in the CDR time period
u_1 = wind speed (10 KPH)
A = 4 KM
H_1 = A+d_1
d_1 = u_1 x t_1

FigureB.1-I, Type "P", Case "1".

(1) Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map. (Figure B.1 - I).

(2) Draw a circle with a radius (A) of 4 km, around the center of the attack location. The area within this circle represents the attack area.

(5) Draw a circle with a radius (H_1) that equals the radius of the attack area (4 km) plus the downwind travel distance (d_1). Distance d_1 is equal to the wind speed (u_1) for the CDR time period, times the remaining time (t_1) from the attack within that CDR time period. For Type "**P**", Case "1", a wind speed of 10 KPH is assumed. This circle will represent the hazard area.

(6) Prepare and transmit an NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs. (Figure B.1 - I).

b. Type "P", Case "2".

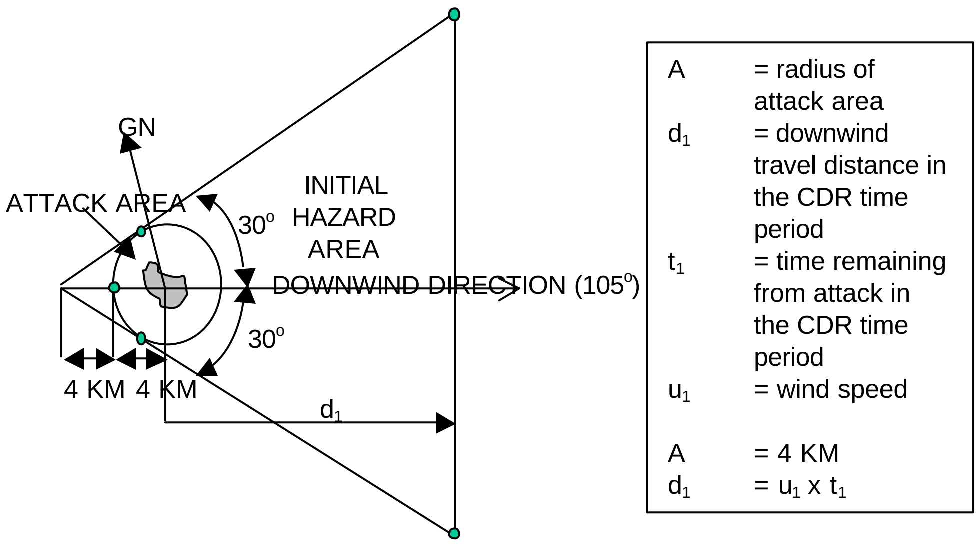


Figure B.1-II, Type "P", Case "2".

(1) Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map. (Figure B.1 - II).

(2) From the center of the attack location, draw a Grid North line (GN Line).

(3) Draw a circle, radius 4 km, around the center of the attack location. The area within this circle represents the attack area.

(4) Using the valid NBC CDM, identify the downwind direction and the downwind speed.

(5) From the center of the attack area, draw a line showing the downwind direction.

(6) Determine the Downwind Travel Distance, d_1. (See para B.1-25.a.)

(7) Plot the maximum downwind travel distance from the center of the attack area on the downwind direction line.

(8) From the maximum downwind travel distance, draw a line at right angles to the downwind direction line. Extend the line to either side of the downwind direction line.

(9) Extend the downwind direction line 8 km upwind from the center of the attack area. This is equal to twice the radius of the attack area.

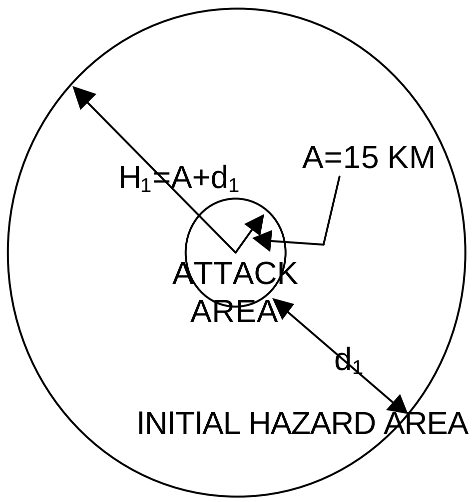
(10) From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the perpendicular to the downwind direction line. (See (8) above). These lines will form a 30° angle either side of the downwind direction line.

(11) The hazard area is taken to be the area bounded by:

(a) The upwind edge of the attack area circle.
(b) The two 30° tangents.
(c) The perpendicular to the downwind direction line. See Figure B.1 - II.

(12) Prepare and transmit an NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs. (Figure B.1 - II).

c. Type "Q", Case "1".



A = radius of attack area
H_1 = radius of initial hazard area
d_1 = downwind travel distance in the CDR time period
t_1 = time remaining from attack in the CDR time period
u_1 = wind speed (10 KPH)
A = 15 KM
H_1 = A+d_1
d_1 = u_1 x t_1

Figure B.1-III, Type “Q”, Case “1”.

(1) Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map. (Figure B.1 - III).

(2) Draw a circle with a radius of 15 km around the center of the attack location. The area within this circle represents the attack area.

(3) Draw a circle with a radius equal to the distance d_1 (10 KPH times the travel duration) plus the radius of the attack area (15 km.). This circle will represent the hazard area.

(4) Prepare and transmit an NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs.

d. Type "Q", Case "2".

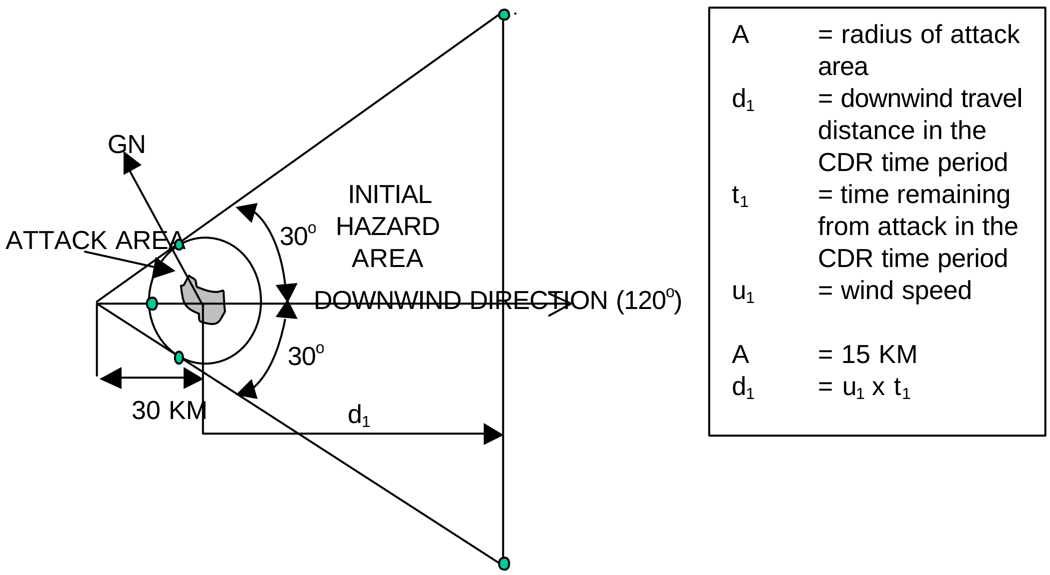


Figure B.1-IV, Type "Q", Case "2".

(1) Obtain the location of the attack from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map. (Figure B.1 - IV).

(2) From the center of the attack location, draw a Grid North line (GN Line).

(3) Draw a circle with a radius of 15 km, around the center of the attack location. The area within this circle represents the attack area.

(4) Using the valid NBC CDM, identify the downwind direction and the downwind speed.

(5) From the center of the attack area, draw a line showing the downwind direction.

(6) Determine the Downwind Travel Distance, d_1 (See para B.1-25.a.).

(7) Plot the downwind travel distance from the center of the attack area on the downwind direction line.

(8) From the downwind travel distance, draw a line at right angles to the downwind direction line. Extend the line to either side of the downwind direction line.

(9) Extend the downwind direction line 30 km upwind from the center of the attack area. This is equal to twice the radius of the attack area.

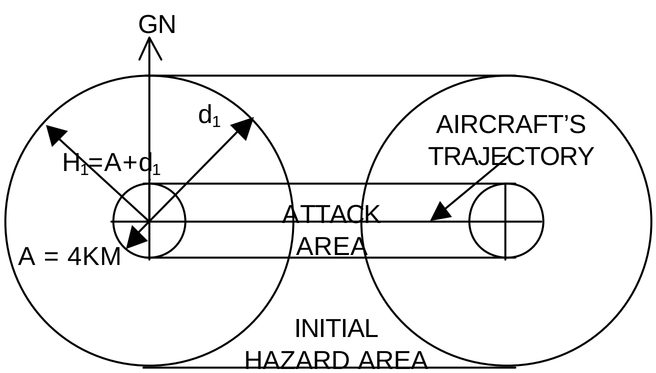
(10) From the upwind end of this line, draw 2 lines that are tangents to the attack area circle, and extend them until they intersect with the perpendicular to the downwind direction line. (See (8) above). These lines will form a 30° angle either side of the downwind direction line.

(11) The hazard area is taken to be the area bounded by:

(a) The upwind edge of the attack area circle.
(b) The two 30° tangents.
(c) The perpendicular to the downwind direction line. See Figure B.1 - IV.

(12) Prepare and transmit an NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs. (Figure B.1 - IV).

e. Type "R", Case "1".



A = radius of attack area
H_1 = radius of initial hazard area
d_1 = downwind travel distance in the CDR time period
t_1 =time remaining from attack in the CDR time period
u_1 = wind speed (10 KPH)

$A = 4km$
$H_1 = A + d_1$
$d_1 = u_1 \times t_1$

Figure B.1-V, Type "R", Case "1".

(1) Obtain the locations of the attack end points from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map.

(2) Draw a 4 km radius circle around each end point.

(3) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.

(4) Draw a circle with a radius equal to the distance d_1 (10 KPH times the travel duration) plus the radius of the attack area (4 km). This circle will represent the hazard area.

(5) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the hazard area (Figure B.1 - V).

(6) Prepare and transmit an NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs. (Figure B.1 – V).

f. Type "R", Case "2".

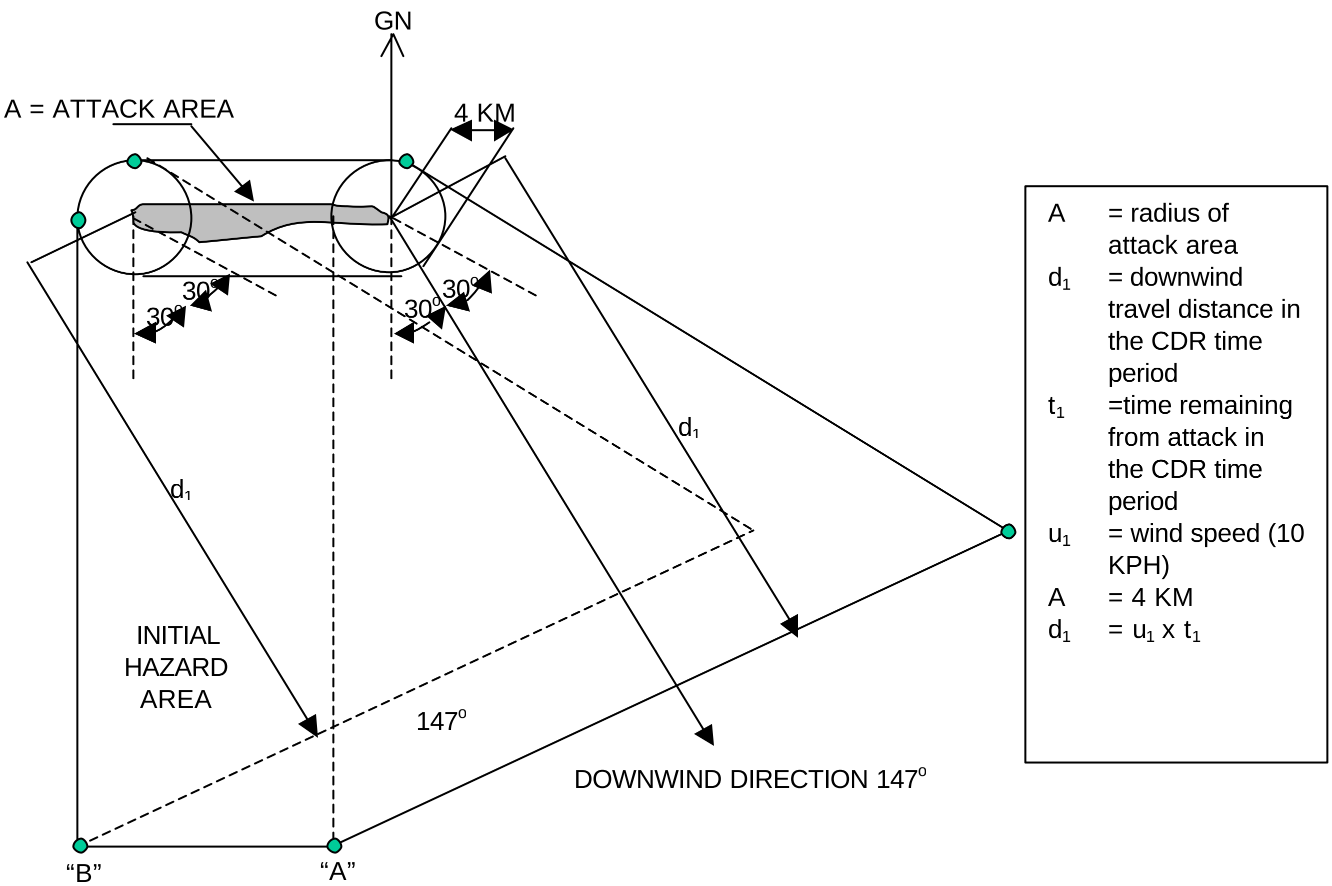


Figure B.1-VI, Type "R", Case "2".

(1) Estimate the attack area from the NBC 1 BIO or NBC 2 BIO (set FOXTROT) and plot it on a map. (Figure B.1 - VI).

(2) Draw a 4 km radius circle around each point.

(3) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.

(4) Draw a Grid North line from the center of each circle.

(5) Using the valid NBC CDM, identify the downwind direction and the downwind speed.

(6) From the center of each attack area circle, draw a line showing the downwind direction.

(7) Determine the Downwind Travel Distance, d_1 (See para B.1-25.a.).

(8) Plot the maximum downwind travel distance from the center of each attack area circle on the downwind direction lines.

(9) From the downwind travel distance, draw a line at right angles to each of the downwind direction lines. Extend the lines to either side of the downwind direction lines.

(10) Extend the downwind direction lines 8 km upwind from the center of the attack area. This is equal to twice the radius of the attack area.

(11) From the upwind end of each line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the perpendiculars to the downwind direction lines. (See (10) above). These lines will form a 30° angle either side of the downwind direction lines.

(12) Draw a line connecting the downwind corners of the 2 hazard areas (Points "A" and "B" in Figure B.1 - VI).

(13) Prepare and transmit an NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs. (Figure B.1 - VI).

g. Type "S", Case "1" and "2".

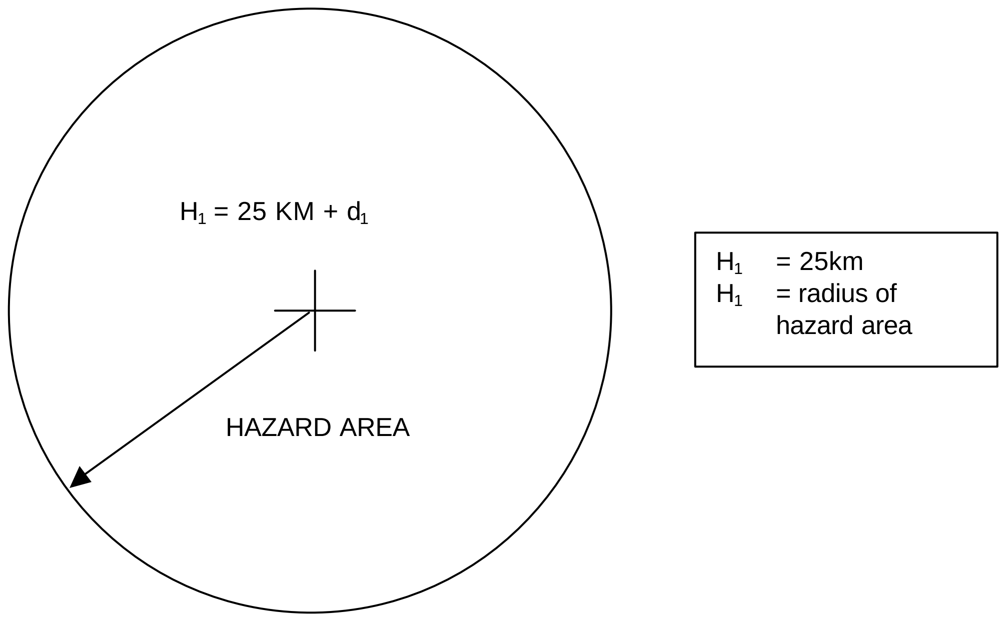


Figure B.1-VII, Type “S”, Case “1” and “2”.

(1) Obtain the location of the detection from the relevant NBC BIO message(s) (set FOXTROT) and plot it on the map. (Figure B.1 - VII).

(2) Draw a circle with a radius of 25 km, around the center of the detection location. The area within this circle represents both the attack area and the hazard area.

(3) Prepare and transmit a NBC 3 BIO to units and installations in the predicted hazard area in accordance with SOPs. (Figure B.1-VII).

Hazard Areas for the First NBC CDR.

B.1-33. When the wind direction does not change by 30 degrees or more, and does not drop below 10 KPH, the total downwind distance can be used to calculate a single hazard area as shown in Figure B.1-IX. The leading and trailing edges should also be computed, starting at the attack location. The leading and trailing edges should be displayed with lines drawn perpendicular to the downwind distance path, extending to the tangent lines.

B.1-34. When the wind direction changes by 30 degrees or more or the wind speed changes between Case "**1**" and Case "**2**", the recalculation procedures from para 1213 should be used for Type "**A**" chemical, as shown in Figure B.1-X.

(1) Draw the attack area circle and initial hazard area for the NBC CDR time period containing the attack. For type **"S"** attack, draw a 25 km radius circle centered on the observation location and wait for more information.

(2) The hazard area at the end of that time period is drawn as a circle centered at the downwind edge ($\mathbf{d_1}$) having a radius equal to the distance along the perpendicular line from the downwind direction line to one of the tangents.

(3) If the next time period is Case "**1**" extend this circle by the distance $\mathbf{d_2}$.

(4) If the next time period is Case "**2**" draw a new downwind direction line for the new time period of distance $\mathbf{d_2}$ from the end of the $\mathbf{d_1}$ line. Repeat the triangle procedure from B.1-32b. with the circle just drawn being the new attack area.

(5) Draw the circle containing the hazard area at the end of the second time period as for the end of the first time period.

(6) Construct the hazard area for the third time period as described for the second time period. For Case "**2**", use the extended distance **DE** to include the leading edge.

(7) The hazard area for the current NBC CDR includes the combined areas drawn for the initial hazard area and hazard areas associated with the second and third time periods, if applicable.

B.1-35. A NBC 3 BIO should be generated corresponding to the current NBC CDR time periods. The hazard area defined in set PAPAX should only include those points computed for the current NBC CDR.

B.1-36. The leading and trailing edges are computed along the downwind distance path, starting at the attack location. The leading and trailing edges should be displayed with lines drawn perpendicular to the downwind distance path, extending to the tangent lines for the time period containing each distance.

B.1-37. For Type "**S**" attacks notice should be taken of the location of enemy positions further upwind of the hazard area, calculated in accordance with para B.1-32.g. The area between the enemy positions and the template should be considered as being potentially BIO contaminated, with appropriate warnings issued and protective measures taken.

Hazards Beyond the First NBC CDR.

B.1-38. If actual measured meteorological conditions have been recorded during a current NBC CDR, the downwind hazard area should be recalculated, as a better estimate of the current hazard area will be obtained. (See para B.1-7.e.). The third time period for the recalculation is not to be extended to include the leading edge, e.g. distance $\mathbf{d_3}$ should be used in place of distance **DE**; however, the leading and trailing edge distances still need to be computed and plotted. If measured meteorology is not available the NBC CDR will not change, so only the third time period needs to be recalculated using distance $\mathbf{d_3}$ in place of **DE.**

B.1-39. An attack circle for the end of the current NBC CDR is drawn centered at the current downwind location and then extended to the tangent lines, as described in B.1-33.b.(2). This attack circle defines the extent of the cloud at the end of the current NBC CDR. If this circle does not include both the leading and trailing edge distances, the circle radius should be enlarged around the current downwind location until both points are included.

B.1-40. The hazard area for the next 6 hour time period should be computed when the next NBC CDR is received. The procedures in paras B.1-31, B.1-32, and B.1-33 are used. If the next NBC CDR has not been received, the last time period for the current NBC CDR should be used for WHISKEYM, XRAYM, and YANKEEM. When the next NBC CDR is received, the hazard prediction should be recalculated. The hazard area should then be reported in PAPAX of a new NBC 3 BIO.

B.1-41. The recalculation of Figure B.1-IX is shown in Figure B.1-XI with the new attack area adjusted to include the leading and trailing edges. The recalculation of Figure B.1-X is shown in Figure B.1-XII with the new attack area. The attack area does not need to be enlarged to contain the leading and trailing edges for this case.

B.1-42. Hazard areas should continue to be computed until no further contamination can be confirmed, or until the hazard duration that follows in para B.1-43 has been reached. Attention should still be paid to the previously calculated areas, which may be contaminated until the end of agent effectiveness.

Hazard Duration.

B.1-43. Upon confirmation of a specific biological agent or toxin, the expected duration of viability of the agent should be recorded in the second field of set PAPAA. The attack area radius computed for the current NBC CDR should be entered into the first field of set PAPAA. This duration may be obtained from a data base on such agents. Agents may continue to be a hazard on the ground in the contaminated area from days to potentially years.

Expected Arrival Times.

B.1-44. The expected arrival time for a biological cloud can be computed by using the downwind distance path and the wind speed for each time period multiplied by 1.5. The latest time of arrival for a biological cloud can be computed by using the downwind distance path and the wind speed for each time period multiplied by 0.5. Arrival times are computed using these adjusted wind speeds and the downwind travel distances for each time period.

B.1-45. A line should be drawn perpendicular to the downwind distance path, which passes through the point of attack. For the time period containing the point of attack, the distance along the downwind path to the perpendicular line is divided by the adjusted wind speed. For previous time periods the downwind travel distance is divided by the adjusted wind speed. The expected arrival time or latest time of arrival is the sum of the contributing times, from the last time period back through the time period containing the attack. Some residual airborne cloud mass may remain behind the area contained between the leading and trailing edges.

B.1-46. Calculated arrival times are used for warning only. The actual arrival can only be determined by detection.

SECTION IX – TERMINATION OF BIOLOGICAL HAZARD ASSESSMENT

B.1-47. For biological attack Types "**P**", "**Q**" and "**R**" where the NBC 3 BIO was generated from one or more NBC 1 BIO with chemical agent UNK, the NBC 3 BIO computations may be terminated if a chemical or biological agent is confirmed. Otherwise, biological hazard assessment should continue until further information is available.

B.1-48. The final NBC report is the NBC 6 BIO; this report is a narrative description of biological attacks that have occurred in the reporting unit's area of operation. The NBC 6 BIO contains as much information as is known about the attacks. It is submitted only when requested.

SECTION X – GENERATION AND PROCESSING OF NBC 4 BIO REPORTS

B.1-49. NBC 4 BIO is the recorded result of an initial detection, reconnaissance, survey, or monitoring action at a location being checked for the presence of biological agents. Each QUEBEC/ROMEO/SIERRA/TANGO/WHISKEY/YANKEE/ZULU segment in every NBC 4 BIO is a record of one contamination sample point's location, environment, time of reading, type and level of contamination, method of sampling, and local meteorological conditions. NBC 4 BIO will often be far downwind of the attack area location as defined in the corresponding NBC 2 and 3 BIO, since biological agents will most likely be detected as airborne contamination.

B.1-50. NBC 4 BIO can be assumed to be associated with the same attack if:

- They can be placed in the hazard area for a NBC 3 BIO between the expected earliest and latest times of arrival

or

- They are within 10 km and 2 hours of another NBC 4 BIO, which has already been assigned to an attack.

SECTION XI – GENERATION OF NBC 5 BIO REPORTS

B.1-51. NBC 4 BIOs that have been assigned to the same attack, may be used to produce a NBC 5 BIO. The NBC 5 BIO outlines the area of detection within the downwind hazard area. Unlike NBC 5 CHEM or NBC 5 NUC which outline areas that are still contaminated, the NBC 5 BIO outlines areas through which the airborne contamination has already passed. As such, an NBC 5 BIO only provides a record of where the contamination has been. Therefore, NBC 5 BIO cannot be generated for BIO warning purposes, only reporting. However, the recorded contamination area may be used to confirm and possibly update calculations and reissue NBC 3 BIO for the same attack.

Examples.

Example NBC CDR

AREAM/NDEL1//
ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//
UNITM/-/DGT/KPH/C//
WHISKEYM/090/020/4/15/4/-/2//
XRAYM/090/020/3/17/5/-/1//
YANKEEM/090/020/18/4/5/-/1//

Example NBC 2 BIO

ALFA/US/A234/008/B//
DELTA/231300ZNOV1999/231305ZNOV1999//
FOXTROT/32UPG387764/AA//
GOLF/OBS/AIR/1/BML/20//
INDIA/SURF/BIO/NP/SIBCA//
TANGO/FLAT/SCRUB//
GENTEXT/NBCINFO/
MUNITIONS EXPLODED IN DUST LIKE CLOUDS, AND
INTELLIGENCE HAS INDICATED THAT A BIO ATTACK IS LIKELY//

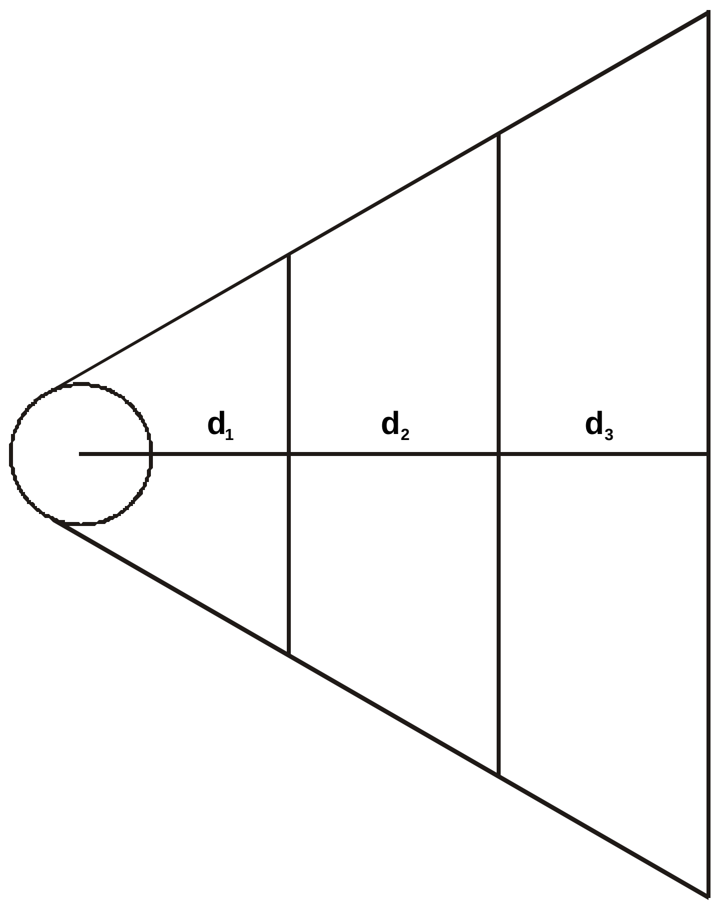


Figure B.1-VIII.
Type Q, Case 2 Attack, 1 hour into NBC CDR, Constant 20 KPH Wind at Constant 90 DGT.

Example NBC CDR

AREAM/NDEL1//
ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//
UNITM/-/DGT/KPH/C//
WHISKEYM/090/020/4/15/4/-/2//
XRAYM/135/020/3/17/5/-/1//
YANKEEM/180/020/18/4/5/-/1//

Example NBC 2 BIO

ALFA/US/A234/009/B//
DELTA/231300ZNOV1999/231305ZNOV1999//
FOXTROT/32UPG387764/AA//
GOLF/OBS/-/-/MSL/1//

INDIA/AIR/BIO/NP/SIBCA//
TANGO/HILL/BARE//
GENTEXT/NBCINFO/
MUNITION EXPLODED IN A DUST-LIKE CLOUD,
INTELLIGENCE INDICATES BIO ATTACK LIKELY//

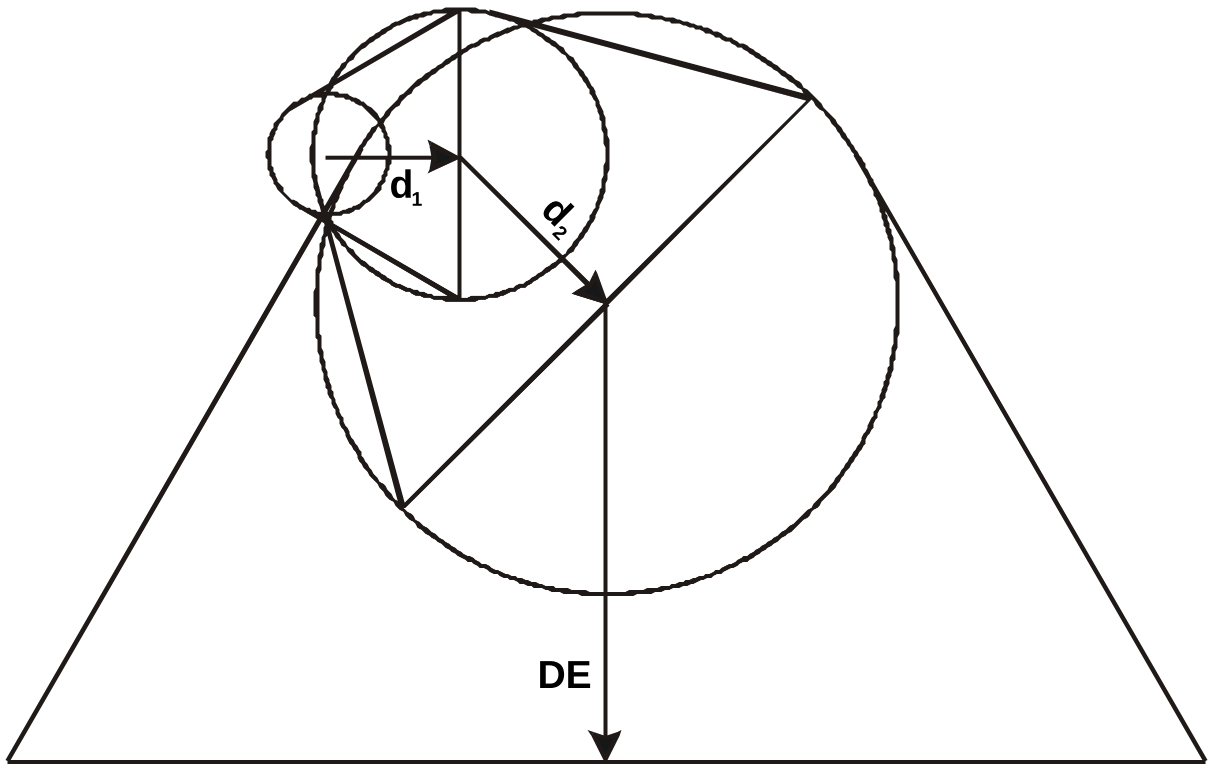


Figure B.1-IX, Type Q, Case 2 Attack, 1 hour into CDR, Changing Downwind Direction.

Example NBC CDR

AREAM/NDEL1//
ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//
UNITM/-/DGT/KPH/C//
WHISKEYM/090/020/4/15/4/-/2//

XRAYM/090/020/3/17/5/-/1//
YANKEEM/090/005/18/4/5/-/1//

Example NBC 2 BIO

ALFA/US/A234/010/B//
DELTA/231500ZNOV1999/231510ZNOV1999//
FOXTROT/32UPG387764/AA//
GOLF/OBS/AIR/1/BML/20//
INDIA/SURF/BIO/NP/SIBCA//
TANGO/FLAT/SCRUB//
GENTEXT/NBCINFO/
MUNITIONS EXPLODED IN DUST LIKE CLOUDS,
INTELLIGENCE INDICATES BIO ATTACK LIKELY//

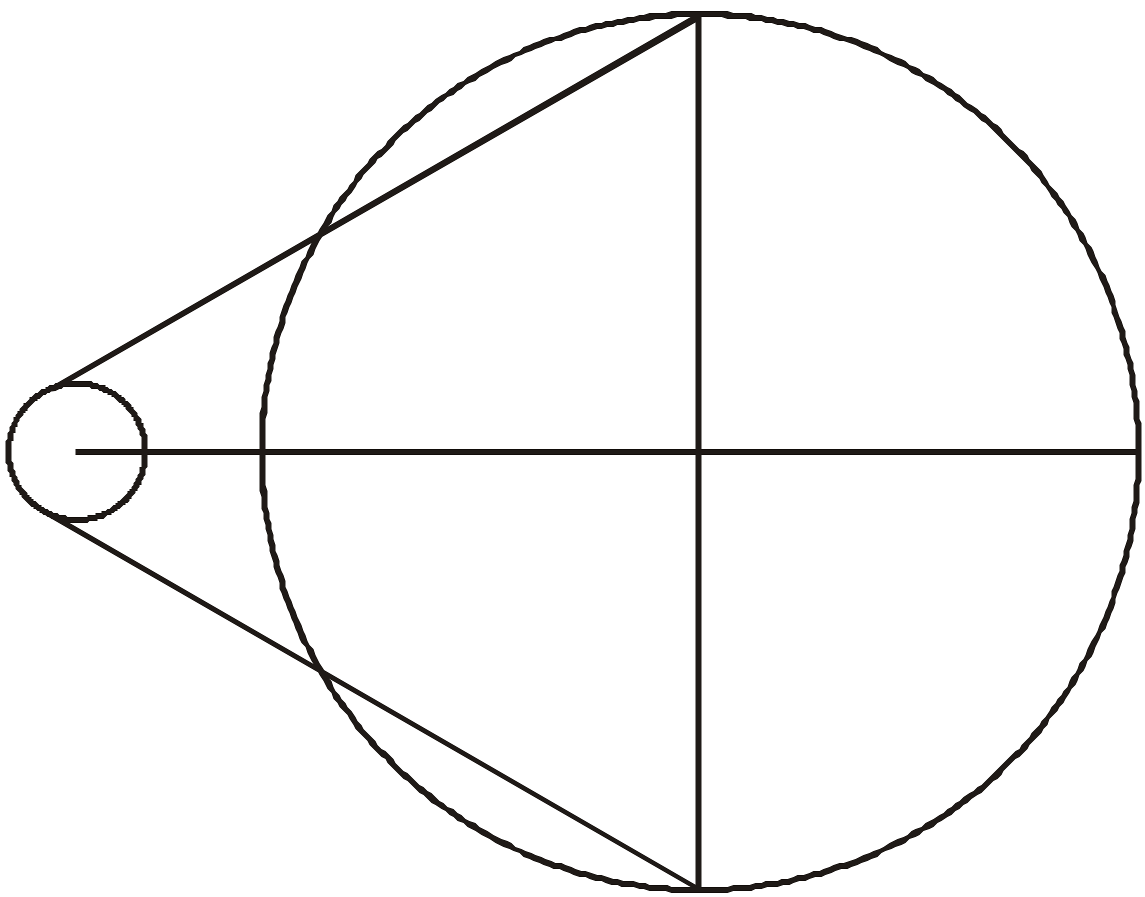


Figure B.1-X, Type Q, Case 2 Attack. Constant Wind Speed and Downwind Direction Using Measured Meteorology.

Example NBC CDR

AREAM/NDEL1//

ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//
UNITM/-/DGT/KPH/C//
WHISKEYM/090/020/4/15/4/-/2//
XRAYM/135/020/3/17/5/-/1//
YANKEEM/180/020/18/4/5/-/1//

Example NBC 2 BIO

ALFA/US/A234/010/B//
DELTA/231300ZNOV1999/231305ZNOV1999//
FOXTROT/32UPG387764/AA//
GOLF/OBS/-/-/MSL/1//
INDIA/AIR/BIO/NP/SIBCA//
TANGO/HILL/BARE//
YANKEE/090DGT/020KPH//
ZULU/4/15C/4/-/2//
GENTEXT/NBCINFO/
MUNITIONS EXPLODED IN DUST LIKE CLOUDS,
INTELLIGENCE INDICATES BIO ATTACK LIKELY//

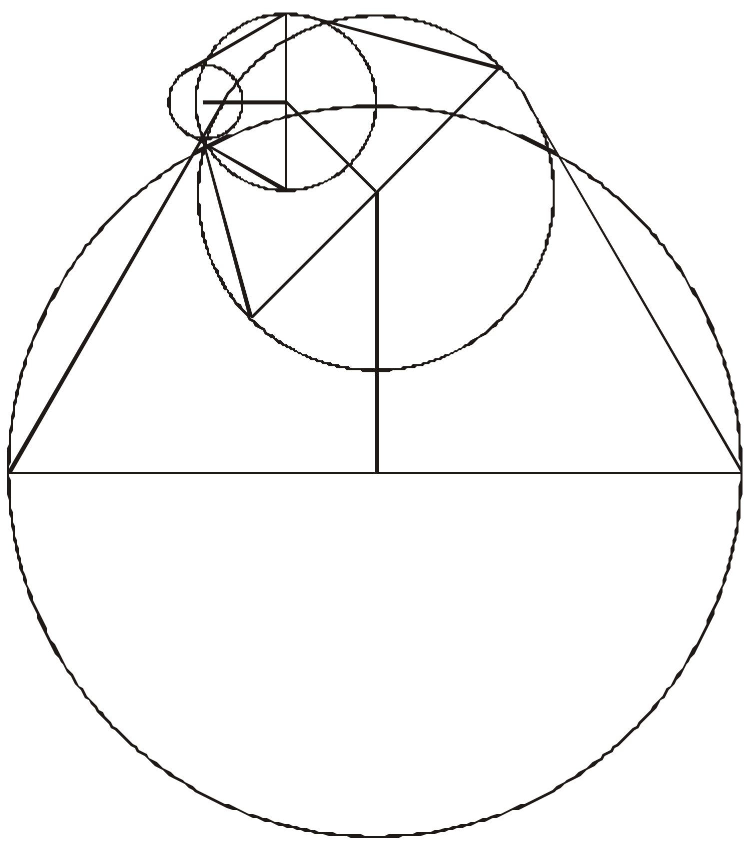


Figure B.1-XI, Type Q, Case 2 Attack. Changing Downwind Direction using Measured Meteorology

Annex 2 to Appendix B

DETERMINATION OF THE LIKELY HAZARD AREA FOLLOWING A CHEMICAL ATTACK, AND THE WARNING OF UNITS WITHIN THE AREA (LAND)

The chemical hazard prediction procedure for land provides information on the location and the possible extent of the hazard area and the possible duration of the hazard resulting from attacks with chemical weapons. These manual procedures listed are safe-sided to compensate for the unknown or changing variables inherent in a chemical agent release such as actual attack location, total mass of chemical agent released, and the microclimate conditions with in the hazard area (wind speed, direction, terrain, and atmospheric stability). This safe-siding is to reduce the risk of not communicating a possible hazard to personnel that may become exposed. However, in an effort to warn and protect as many personnel as possible, the force may become over degradated due to MOPP causing an operational risk. Units can use chemical hazard modelling to balance operational risks with risk of exposure if additional data is available to provide better resolution on the variables listed above. Prior to using modelling, units should gain approval from their higher headquarters and ensure that the operators are properly trainined.

Chemical hazard prediction provides the necessary information for commanders to make these risk decisions and warn units within the predicted hazard area. Chemical hazard predictions are only effective if used in conjunction with what sensors (chemical and meteorological) are reporting in the estimated hazard area. Chemical advisors must also take into consideration the element of time when conducting chemical hazard assessments. The two main functions of time to be considered when translating hazard prediction into risk recommendations and warnings are: time of arrival, and duration of effectiveness of the agent.

A chemical hazard prediction may be done prior to an attack. Using hazard prediction as part of IPB, vulnerability analysis, and R&S planning will provide units with information on possible enemy courses of action, required vulnerability reduction measures for friendly forces, and the allocation and positioning of chemical defense assets. Intelligence systems and air space management systems can provide indications that a chemical attack may be occurring by providing information on weapon system launches.

This provides a possible attack location which units can estimate the possible hazard to warn forces or cue reconnaissance assets.

SECTION I – DEFINITIONS

B2-1. ATTACK AREA. This is the predicted area immediately affected by the delivered chemical agent on land.

B2-2. HAZARD AREA. This is the predicted area in which unprotected personnel may be affected by vapor spreading downwind from the ATTACK AREA. The downwind distance depends on the type of attack, the weather and terrain in the attack area and the area downwind of the ATTACK AREA.

B2-3. CONTAMINATED AREA. This is the area in which liquid hazard may remain some time after the attack. The actual shape and duration can only be determined by surveys.

B2-4. LEVEL OF HAZARD. When a unit uses a transport and dispersion model to determine the predicted effects of the hazard on personnel, the operator will input the levels of hazard based on operational concerns of the command. These levels may be lethal dose for 50% of unprotected personnel (LCt50), incapacitating dose for 50% of unprotected personnel (ICt50), incapacitating dose for 5% of unprotected personnel (ICt5), and concentration required to cause pupil constriction (meiosis). The concentration of agent that defines the level of hazard varies for each agent.

Note: If actual surveys alter the initial data used for determination of the attack the NBC 2 CHEM and/or the NBC 3 CHEM must be changed or updated.

SECTION II – GENERAL

B2-5. The prediction of the attack and hazard area is dependent upon;

- the means of delivery,
- the type of chemical attack, and
- the meteorological factors.

SECTION III – MEANS OF DELIVERY

B2-6. The means of delivery and the type of agent container are listed below:

Delivery System Type

AIR	Aircraft
BOM	Bomb
CAN	Cannon
MLR	Multiple Launched Rocket System
MSL	Missile
MOR	Mortar
PLT	Plant
RLD	Railroad Car
SHP	Ship

TPT	Transport
TRK	Truck or Car
UNK	Unknown

Agent Container Type.

BML	Bomblets
BOM	Bomb
BTL	Pressurised Gas Bottle
BUK	Bunker
CON	Generic Storage Container
DRM	Nominal 200 litre Storage Drum
GEN	Aerosol Generator
MSL	Missile
RCT	Reactor
RKT	Rocket
SHL	Shell
SPR	Spray (tank)
STK	Stockpile
TNK	Storage Tank
TOR	Torpedo
MNE	Mine
UNK	Unknown
WST	Waste

B2-7. In cases where the type of agent container is unknown (UNK), then MLR is to be used for computations.

SECTION IV– TYPES OF ATTACK

B2-8. Chemical attacks can be divided into 2 types:

- Air Contaminating Attacks (Type A) (non persistent agents), and
- Ground Contaminating Attacks (Type B) (persistent agents).

B2-9. A type A attack is to be assumed unless liquid is present which is subsequently confirmed to be a persistent agent.

SECTION V – METEOROLOGICAL FACTORS

B2-10. Influence of Weather on the Effectiveness of Chemical Agents.

(1) Temperature. The rate of evaporation of a liquid chemical agent varies with the temperature. High temperatures will increase the rate of evaporation while lower temperatures will decrease it. Initially the vapor hazard of both persistent and non-persistent agents will be greater at higher temperatures, while the duration of the liquid contamination and vapor hazard will be shorter. Lower temperatures will have just the opposite effect. It should be noted that lower temperatures may

actually reduce or even eliminate casualty potential. However, a contact hazard may remain for several days.

(2) Air Stability Category. The air stability category describes the degree of mixing of a released agent with the air in the lower atmosphere. There are three general air stability categories:

(a) **Stable**. Under stable conditions there is little mixing and thus higher concentrations, and the agent cloud will be effective over long distances.
(b) **Neutral.** Under neutral conditions, the intermediate range, is most common.
(c) **Unstable**. Under unstable conditions there is strong mixing and thus shorter hazard distances.

(3) Wind. High winds increase the rate of evaporation of the liquid chemical agent and the rate at which chemical clouds are dissipated. The effect on persistent agent attacks is variable. Large area non-persistent agent attacks are most effective in winds not exceeding 28 KPH. Small area non-persistent agent attacks are most effective in winds not exceeding 10 KPH. High winds generally increase the effectiveness of massive non persistent agent surprise attacks. The wind speed and direction will affect the spread of chemical clouds.

(4) Humidity and Precipitation. Humidity and precipitation alter the effects of chemical agents in different ways. High humidity, for example, will increase the effectiveness of blister agents, but will not directly affect the effectiveness of nerve agents.

- Heavy or continuous rain will wash away liquid chemical contamination, and light rain after a liquid attack can cause the recurrence of a contact hazard.
- Rain after a blister or persistent nerve agent attack will temporarily increase the evaporation rate, thus increasing the vapor hazard. Snow reduces the evaporation rate of liquid chemical agent, thus reducing the vapor hazard in the attack area.

(5) Inversion Layers. In most cases the concentration of the chemical agent will decrease with increasing height and reach a low concentration (meiosis level) at approximately 800 meters. Normally there will be no risk above 3000 meters. Certain meteorological conditions in the atmosphere, known as Inversion Layers are associated with stable conditions specified in the NBC CDM/NBC CDF under the term "stability category". Stable conditions usually occur at night or in the morning under conditions of clear skies and low wind speed but will also result any time the ground or water surface is cooler than the air above it. An Elevated Inversion layer occurs when the surface inversion layer decays or under unusual advection conditions. With both inversion and elevated inversion layers the concentration of the chemical agent will be higher within the layer than with no inversion. The concentration of the chemical agent will be very small above the layer. If the height of the top of any inversion layer is lower than 800 meters, this will be indicated in the NBC CDM/NBC CDF by the letter "A" appearing in the coded "significant weather phenomena". If the height of the top is lower than 400 meters, letter "B" is to be used, if lower than 200 meters, letter "C". These letters signify the safe altitudes for aircraft.

B2-11. Influence of Terrain on the Effectiveness of Chemical Agents. The path and speed of a chemical cloud is considerably influenced by the nature of the terrain in the downwind area. Under stable conditions chemical clouds tend to flow over rolling terrain and down valleys. Dangerous concentrations may persist in hollows, depressions and trenches. Chemical clouds tend to go around obstacles such as hills. Chemical clouds tend to be retarded by rough ground, including that covered with tall grass and bushes. Flat terrain allows for an even, steady movement.

B2-12. Meteorological definitions.

(1) Representative Downwind Direction: The mean surface downwind direction towards which the chemical cloud travels in the hazard area. The optimal measuring height should be 10 m above the ground in an open terrain averaged over a period of 10 min.

(2) Representative Downwind Speed: The mean surface downwind speed in the hazard area. The optimal measuring height should be 10 m above the ground in open terrain averaged over a period of 10 min.

(3) Air Stability Category: The stability category is normally reported in the NBC CDR. If it must be determined locally use Table B.2-I and Table B.2-II in this chapter.

(4) When above listed measurements are taken, the results will be the actual Representative Downwind Direction, the Representative Downwind Speed and the Air Stability Category at the time and location of the measurement. When the values are given in a NBC CDM, they will represent average values for the given NBC CDM area in the given 2 hour period.

SECTION VI – NBC CHEMICAL DOWNWIND MESSAGE (NBC CDM)

B2-13. The NBC Chemical Downwind Message (NBC CDM). The meteorological data required for the downwind hazard prediction procedure will be contained in the NBC CDM. It is transmitted 4 times a day and each message is valid for a 6 hour period. Each 6 hour period is subdivided into three 2 hour periods. The NBC CDM can be sent down as far as source level. The NBC CDM contains the following information:

(1) Area of validity.
(2) Date-time groups for time of observation, time valid from and time valid to.
(3) Units of measurement.
(4) Representative downwind direction and downwind speed.
(5) Air stability category.
(6) Surface air temperature.
(7) Relative Humidity.
(8) Significant weather phenomena.
(9) Cloud coverage.

B2-14. The NBC CDM contains weather information valid for 6 hours. The NBC Chemical Downwind Forecast (NBC CDF) has the same content, but the period of validity is more than 6 hours ahead. The NBC CDM and NBC CDF can be contained in a data format, the NBC Chemical Downwind Report (NBC CDR). The detailed computer generated format for the NBC CDM/CDF and the NBC CDR is explained in ATP-45, Annex B.

Sample content of a computer generated NBC CDM:
AREAM/NFEA//
ZULUM/231100ZNOV1999/231200ZNOV1999/231800ZNOV1999//
UNITM/-/DGT/KPH/C//
WHISKEYM/070/022/6/15/-/-/1//
XRAYM/075/025/4/13/9/6/2//
YANKEEM/080/028/4/12/8/-/2//

B2-15. Meteorological requirements. It is the task of a NBC Center to predict chemical hazard areas for chemical clouds. For this purpose the NBC Center must have the necessary meteorological information. National and/or NATO directives must ensure the provision of applicable NBC CDMs and national or local SOPs must list directives for the observation and dissemination of local weather information. If reliable local weather for the whole of the hazard area is available, it should be used. However, the operator with regard to changing weather conditions over time should take the procedure as described below.

B2-16. Change in Meteorological Conditions. If the meteorological conditions change within the period of duration of the hazard, the predicted hazard area must be adjusted only if:

(1) The stability category changes from one category to another, and/or
(2) The wind speed changes by more than 5 knots or from 5 knots or less to more than 5 knots and vice versa, or
(3) The wind direction changes by more than 20 degrees.

B2-17. The hazard area is then determined as follows: Calculate the downwind distance which the agent cloud may have travelled at the time the change in the meteorological conditions occurred, by using the representative downwind speed. Consider this point to be the center point of a “new” attack area, and draw a circle around it with a radius equal to half the width of the hazard area at that point. The distance, which the agent cloud may already have travelled, must be subtracted from the maximum downwind hazard distance under the new weather conditions. (Figure B2-XI).

B2-18. Agent Clouds crossing the Coast Line. When a cloud from a chemical agent crosses the coast line from sea to land or vice versa, consider the point where the downwind direction line (downwind axis) intersects the coast line to be the center point of a “new” attack area, and follow the procedure described in Annex 3 of Appendix B, using the appropriate tables for sea and land to determine the downwind hazard distances.
When frequent changes occur, use the land procedure when working manually.

B2-19. In the case of air contaminating attacks, the beginning and the end of the hazard at a given point may be determined from:

(1) The representative downwind speed.
(2) The distance of the location from the edge of the attack area.

(3) The beginning and the end of the attack.

The following two formulas are used:

$$t_B = (d_A \times 60) / (1.5 \times V_Z) \text{ or}$$
$$t_B = (d_A \times 40) / V_Z \text{ and}$$

$$t_E = (d_B \times 60) / (0.5 \times V_Z) \text{ or}$$
$$t_E = (d_B \times 120) / V_Z = 3 \times t_B$$

$\mathbf{t_B}$ = time in minutes from the beginning of the attack to the beginning of the hazard.

$\mathbf{d_A}$ = distance between the location and the downwind leading edge of the dissemination area (in NM).

$\mathbf{d_B}$ = distance between the location and the downwind trailing edge of the dissemination area (in NM).

$\mathbf{V_Z}$ = wind speed in knots. If necessary, the wind speed must be determined as the mean wind speed over several periods of validity of the NBC CDM.

$\mathbf{t_E}$ = time in minutes from the end of the attack to the end of the hazard.

EXAMPLE:

Given: $\mathbf{d_A}$ = 5 NM, $\mathbf{V_Z}$ = 10 knots.

Using the formulas,

$\mathbf{t_B}$ and $\mathbf{t_E}$ are calculated as follows:
$\mathbf{t_B}$ = (5 NM x 40) / 10 knots = 20 minutes, and
$\mathbf{t_E}$ = (5 NM x 120) / 10 knots = 60 minutes

So, the beginning of the hazard is expected at this location 20 minutes after the beginning of the attack and is expected to end 60 minutes after the end of the attack.

B2-20. The expected maximum duration of the air-contaminating hazard (i.e.; when the calculated hazard is expected to be completely clear), may be obtained by using the maximum downwind hazard distance as $\mathbf{d_A}$, and calculating $\mathbf{t_E}$ from the formulas in para B2-35 above.

B2-21. Units and NBCCs must continuously check the NBC 3 CHEM messages issued, in order to ensure that any new information (meteorological or NBC) is considered. If necessary, a corrected NBC 3 CHEM message must be transmitted.

B2-22. Procedures:

(1) Record and update the following information: Weather information from relevant NBC CDMs, and/or equivalent weather information from local measurements/observations.

(2) Record terrain features and wooded areas etc. that may influence the direction and speed of chemical agent clouds.

(3) On receipt of NBC 1 CHEM or NBC 2 CHEM, as rapidly as possible, estimate the meteorological parameters for the attack area and downwind of the attack area.

(4) Select, in accordance with national directives, the weather information to be used and calculate the predicted downwind hazard area.

B2-23. Constraints.

(1) When calculating the predicted downwind hazard area from chemical attacks, many factors will affect the accuracy of the prediction. Some of these factors are:

- Type of and amount of chemical agents.
- Type of and amount of agent containers.
- Terrain composition.
- Weather (rain, clouds etc.).
- Air stability.
- Type of surface(s).
- Vegetation(s).
- Surface air temperature.
- Relative Humidity
- and changes to these factors.

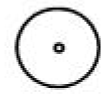
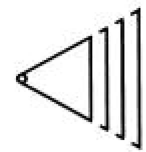
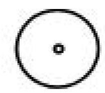
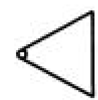
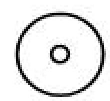
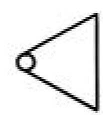
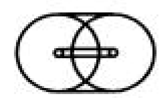
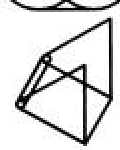
(2) Some of these factors are not considered when using the procedures in this chapter, unless evaluated and estimated manually by the user.

(3) The procedure shown in this chapter is based on the limited amount of information available at the time of attack.

(4) To be able to make more accurate predictions, more information about the listed factors has to be available and more sophisticated methods have to be used for prediction. Such procedures can be accomplished through modelling or using additional procedures outline in ATP-45 or AEP-45.

SECTION VII –CHEMICAL HAZARDS

B2-24. Types and Cases of Chemical Attacks. Chemical attacks are divided into two types “A” air contaminating attacks and “B” ground contaminating attacks. These are further subdivided into cases based on radius of attack area and the wind speed. These are outlined in the table below. Procedures for determining the downwind hazard are detailed in Section II.

TYPE OF AGENT CONTAINER	RADIUS OF ATTACK AREA	LINEAR ATTACK AREA	WIND SPEED	TYPE	CASE	FIGURE
BML, BOM, RKT, SHL, MNE, UNK, surface burst MSL	≤ 1 km		≤ 10 KPH	A	1	
BML, BOM, RKT, SHL, MNE, UNK, surface burst MSL	≤ 1 km		> 10 KPH		2	
BML, SHL, MNE, surface burst RKT and MSL	≤ 1 km		≤ 10 KPH	B	1	
BML, SHL, MNE, surface burst RKT and MSL	≤ 1 km		> 10 KPH		2	
BOM, UNK, air burst RKT and MSL	> 1, ≤ 2 km		≤ 10 KPH		3	
BOM, UNK, air burst RKT and MSL	> 1, ≤ 2 km		> 10 KPH		4	
SPR, GEN		> 2 km	≤ 10 KPH		5	
SPR, GEN		> 2 km	> 10 KPH		6	

SECTION VIII– PREDICTION OF THE DOWNWIND HAZARD

B2-25. Chemical Hazards. After an attack by chemical agents 3 types of hazard can be encountered by personnel dependent on their position relative to the attack area. These are a **liquid** hazard, a **vapor** hazard or both a **liquid** and a **vapor** hazard.

a. **Liquid Hazard.** Personnel in an area contaminated with liquid chemical agents will be exposed to a hazard that varies according to:

- The type and amount of agent disseminated.
- The method of dissemination.
- The local climatic conditions.
- The nature of the terrain.
- The time lapse after the contamination.
- Liquid agents may under very cold conditions completely stop evaporating and result in an all clear survey. A hazard can be recreated when temperatures rise.

(1) Non Persistent Agents. Most non persistent agents are disseminated mainly as vapor, but some of the agent types may leave unevaporated liquid in shell or bomb craters for either hours or days depending upon the climatic conditions and the munition type. Craters should be avoided until tests have proved the absence of a liquid hazard.

(2) Persistent Agents. Persistent agents are disseminated as liquid and present a vapor hazard as well as a contact hazard. This hazard will last for several hours to days depending on the terrain, climatic conditions and munition type.

(3) Border areas. Some agents normally classified as non persistent may behave as persistent agents in very cold environments, and liquid from both non persistent and persistent agents may freeze at low temperatures e.g. HD freezes at temperatures below 14°C, and can present a delayed hazard to personnel when the temperature rises.

(4) Thickened, non persistent agents may have to be treated as persistent, ground contaminating agents. Blister agents are normally classified as persistent agents and will be so indicated when detected by three way detection paper. Some agents however, are very volatile and should be treated as non persistent, but still ground contaminating agents.

b. **Vapor Hazard.** All chemical agents present a vapor or aerosol hazard to personnel downwind of the attack area. The area covered by this hazard may be estimated by using prediction techniques. The actual downwind distance covered by a toxic cloud will depend on the type and amount of agent disseminated, the method of dissemination, the climatic conditions and the terrain.

B2-26. Chronology.

a. Unprotected personnel in an attack area will be exposed to the chemical agent hazards unless they take immediate protective action at the first indication of an attack.

b. The dimensions of the downwind hazard area will depend on the means of delivery, the category of agent, the type of attack, and on weather and terrain. The cloud arrival time at positions downwind of the attack point or area will depend on the **representative downwind speed**.

c. The ability to provide timely warning to personnel downwind of the point or area of attack, will depend on the time taken to learn of the attack, the time taken to predict a downwind hazard area and the time required to transmit the warning to those in the hazard area. However units do not have to automatically put everyone in the hazard area into protective posture. Advisors need to consider the expected time of arrival of the agent cloud, sensor information, and mission requirements before recommending protective posture.

B2-27. Principles and Limitations.

a. It is assumed, that once chemical warfare has been initiated, troops in areas attacked by aircraft or missiles, or coming under artillery or other bombardments, will immediately and automatically carry out appropriate chemical defence drills, whether or not a chemical alarm has been given.

b. An attacked unit will attempt to warn all friendly forces in the immediate vicinity, using its standard operating procedures.

c. In fixed installations, and in other cases, where established communications and/or alarms are available, these can also be used.

d. Units and installations warned in this way should not promulgate the alarm beyond their own area.

Note: As soon as a commander/NBC center realizes that completion and submission of a NBC 3 CHEM would not warn a unit in the hazard area in time, they will attempt to pass the alarm by the most expeditious means available.

e. Simultaneously, a report of the attack should be made to the NBC Collection/Sub Collection Center. This immediate report will be followed by a formatted NBC report, in accordance with Chapter 5.

f. The NBC Collection/Sub Collection Center will use this information to provide timely warning to units and/or installations in the predicted downwind hazard area. Due to climatic and geographical variations, the lateral limits of the predicted hazard area are normally to be defined by an angle of lateral spread 30° on either side of the forecast representative downwind direction.

g. The hazard area prediction will be less reliable as the distance from the point of emission increases.

h. Units in the downwind hazard area, warned by a NBC Collection/Sub Collection Center, will not raise an alarm outside their own area, but will submit a NBC 4 CHEM in accordance with SOPs on the actual arrival of the chemical agent cloud.

i. The limiting dosages of agents assumed in establishing the procedures for hazard area prediction, while not sufficient to produce casualties immediately, may produce later effects, i.e. meiosis from nerve agents.

j. Simplified procedures for obtaining Downwind Hazard Distance is contained in Table B.2-III.

B2-28. Type "A" Attack Downwind Hazard Prediction. The following information is required:

- NBC 1 CHEM or NBC 2 CHEM
- Detailed MET information e.g. NBC Chemical Downwind Message (NBC CDM), or similar information.

Note: If detailed MET information is not available, the air stability category should be determined by using Table B.2 - I, and this category should be adjusted using Table B.2 - II. The **representative downwind direction** and **downwind speed** must be measured locally.

B2-29. Type "A", Case "1". (NOT TO SCALE)

(1) Obtain the location of the attack from the relevant NBC CHEM message(s) and plot it on the map. (Figure B.2 - I).

(2) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(3) Draw a circle, radius 10 km, around the center of the attack location. The area within this circle represents the hazard area.

(4) Prepare and transmit NBC 3 CHEM to those units and installations within the hazard area in accordance with SOPs.

Example NBC 3 CHEM

ALFA/UK/A234/001/C//
DELTA/271630ZAPR1999//
FOXTROT/33UUB206300/AA//
INDIA/SURF/NERV/NP//
PAPAA/01KM/-/10KM/-//
PAPAX/271600ZAPR1999/-//
YANKEE/105DGT/009KPH//
ZULU/4/18C/9/-/2//
GENTEXT/NBCINFO/TYPE A, CASE 1//

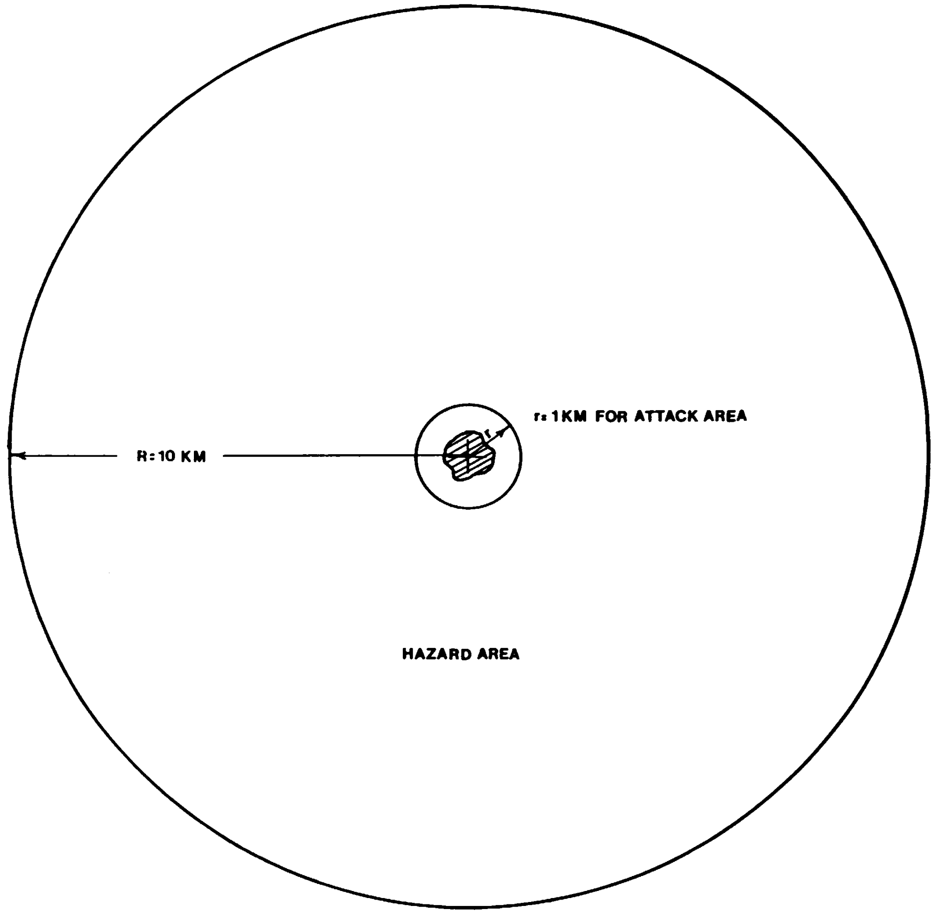


**Figure B.2-I, Hazard Area from Type "A" Attack, Case "1" .
Wind Speed 10 KPH or Less.**

B2-30. Type "A", Case "2". (<u>NOT TO SCALE)</u>

(1) Obtain the location of the attack from the relevant NBC CHEM message(s) and plot it on the map. (Figure B.2 - II).

(2) From the center of the attack location, draw a Grid North line (GN Line).

(3) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(4) Using the valid NBC CDM, or from locally measured data, identify the air stability category (Table B.2 - I and 12 - II), the representative downwind direction and the downwind speed.

(5) From the center of the attack area, draw a line showing the representative downwind direction.

(6) Determine the Downwind Hazard Distance.

- Simplified procedure; if no more detailed information is available, go to Table B.2 - III using the appropriate air stability category and means of delivery.
- Detailed procedure; if more detailed information is available regarding agent type, means of delivery and wind speed use the tables in Appendix B, Annex D or the equations in ATP-45, Appendix D-26.
-

Note: When information concerning means of delivery is not available, use the figures for multiple launched rocket systems, missiles, bombs and unknown munitions.

(7) Plot the maximum downwind distance from the center of the attack area on the representative downwind line.

(8) From the maximum downwind distance, draw a line at right angles to the representative downwind direction line. Extend the line either side of the downwind direction line.

(9) Extend the representative downwind line, upwind from the center of the attack area, 2 km. This is equal to twice the radius of the attack area.

(10) From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the maximum downwind distance line. (See (8) above). These lines will form a 30° angle either side of the representative downwind line.

(11) The hazard area is taken to be the area bounded by:

(a) The upwind edge of the attack area circle.
(b) The two 30° tangents.
(c) The maximum downwind distance line. See Figure B.2 - II.

(12) Prepare and transmit NBC 3 CHEM to units and installations in the predicted hazard area in accordance with SOPs.

Example NBC 3 CHEM

ALFA/UK/A234/003/C//
DELTA/271647ZAPR1999//
FOXTROT/32UPG560750/AA//
INDIA/AIR/NERV/NP//
PAPAA/01KM/-/10KM/-//
PAPAX/271600ZAPR1999/
32UPG674791/
32UPG557759/
32UPG550752/
32UPG552742/

32UPG638657//
YANKEE/105DGT/015KPH//
ZULU/2/15C/8/-/2//
GENTEXT/NBCINFO/TYPE A, CASE 2, DHD 10KM//

Note: In order that a recipient of a NBC 3 CHEM be able to plot the downwind hazard easily and quickly, set GENTEXT/NBCINFO may contain the type, case and the downwind hazard distance (DHD).

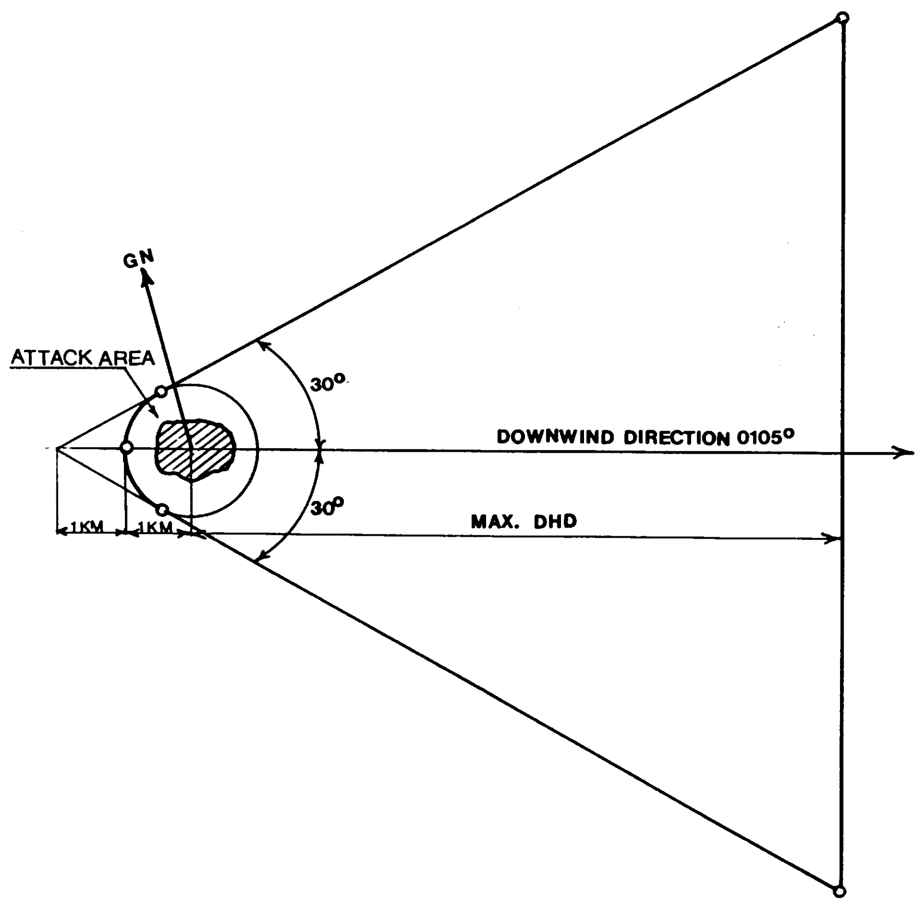


Figure B.2-II, Hazard Area from Type "A" Attack, Case "2". Wind Speed more than 10 KPH.

B2-31. Type "B" Attack Downwind Hazard Prediction. The following information is required:

- NBC 1 CHEM or NBC 2 CHEM,
- The daily mean surface temperature.
- Detailed Met information e.g. NBC CDM, or similar information.

B2-32. The daily mean surface temperature is needed for the estimation of the probable time after which personnel may conduct umasking procedures. (Table B.2 - IV). The air stability category is not considered in Type "B" hazard prediction as the maximum downwind distance is always 10 km.

B2-33. Type "B", Case "1". (NOT TO SCALE)

(1) Obtain the location of the attack from the relevant NBC CHEM message(s) and plot it on the map. (Figure B.2 - III).

(2) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(3) Draw a circle, radius 10 km, around the center of the attack location. The area within this circle represents the hazard area.

(4) Prepare and transmit NBC 3 CHEM to those units and installations within the hazard area in accordance with SOPs.

Example NBC 3 CHEM
ALFA/UK/A234/001/C//
DELTA/271630ZAPR1999//
FOXTROT/33UUB206300/AA//
INDIA/SURF/NERV/P//
PAPAA/01KM/-/10KM/-//
PAPAX/271600ZAPR1999/-//
YANKEE/105DGT/009KPH//
ZULU/4/18C/9/-/2//
GENTEXT/NBCINFO/TYPE B, CASE 1//

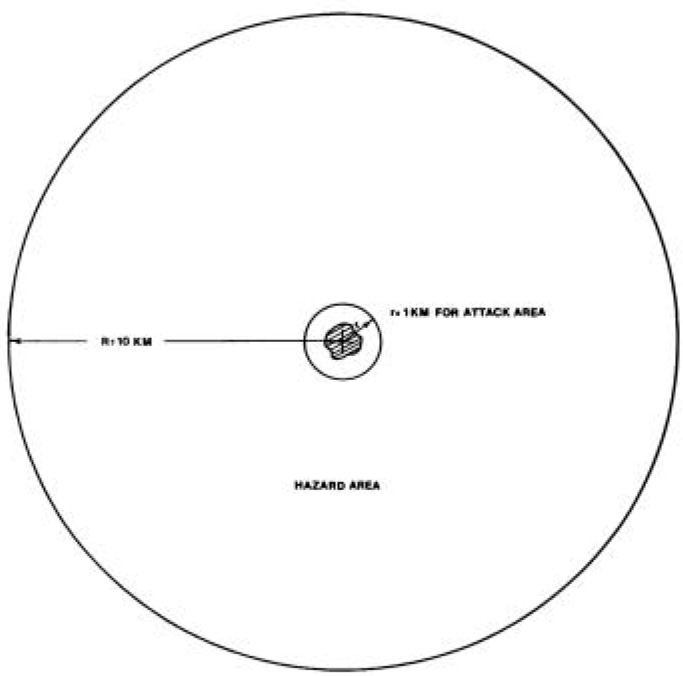


Figure B.2-III, Hazard Area from Type "B" Attack, Case "1" . Wind Speed 10 KPH or Less.

B2-34. Type "B", Case "2". (NOT TO SCALE)

(1) Obtain the location of the attack from the relevant NBC CHEM message(s) and plot it on the map. (Figure B.2 - IV).

(2) From the center of the attack location, draw a Grid North line (GN Line).

(3) Draw a circle, radius 1 km, around the center of the attack location. The area within this circle represents the attack area.

(4) From the center of the attack area, draw a line showing the representative downwind direction.

(5) Plot the 10 km downwind distance from the center of the attack area on the representative downwind line.

(6) From the 10 km downwind distance, draw a line at right angles to the representative downwind direction line. Extend the line either side of the downwind direction line.

(7) Extend the representative downwind line, upwind from the center of the attack area, 2 km. This is equal to twice the radius of the attack area.

(8) From the upwind end of this line, draw 2 lines which are tangents to the attack area circle, and extend them until they intersect with the 10 km downwind distance line. (See (6) above). These lines will form a 30° angle either side of the representative downwind line.

(9) Using Table B.2 - IV, find the probable time after ground contamination at which personnel may conduct umasking procedures.

(10) Prepare and transmit NBC 3 CHEM to units and installations in the predicted hazard area in accordance with SOPs.

Example NBC 3 CHEM

ALFA/UK/A234/011/C//
DELTA/271650ZAPR1999//
FOXTROT/32UNH250010/AA//
INDIA/AIR/NERV/P//
PAPAA/01KM/2-4DAY/10KM/1-2DAY//
PAPAX/271600ZAPR1999/
32UNH371020/
32UNH250020/
32UNH241015/
32UNH241005/
32UNG301900//
YANKEE/120DGT/015KPH//
ZULU/2/15C/8/-/2//
GENTEXT/NBCINFO/TYPE B, CASE 2//

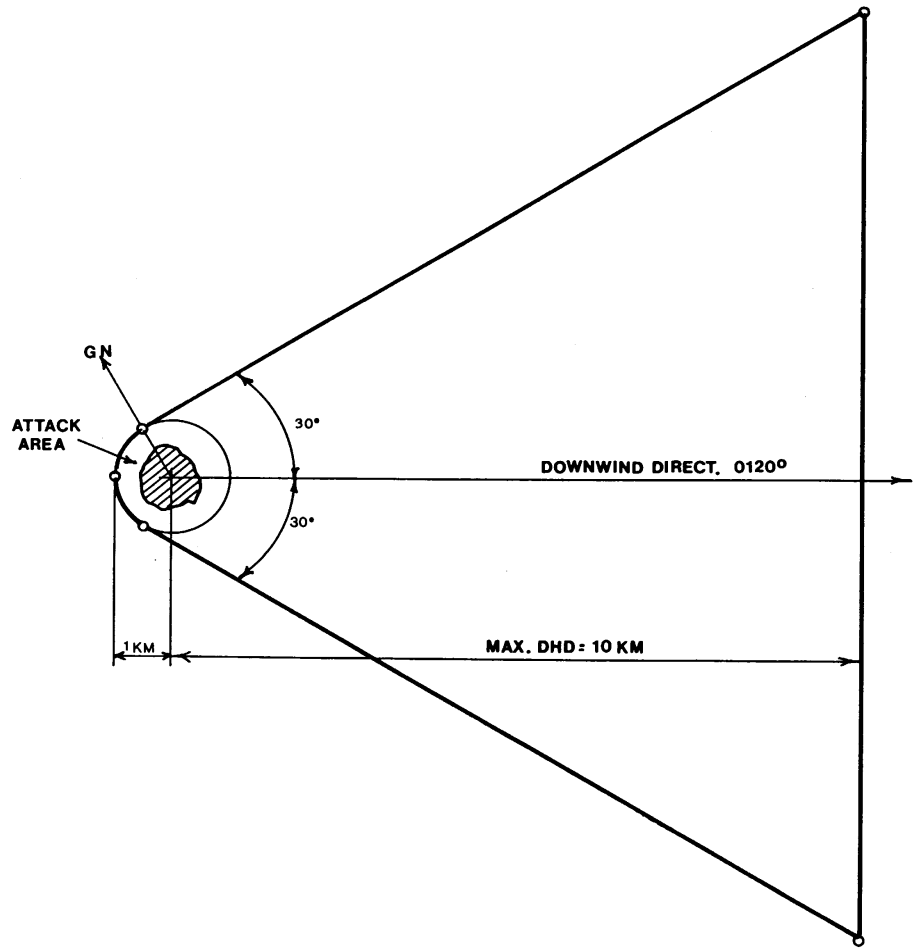


Figure B.2-IV, Hazard Area from Type "B" Attack, Case "2".
Radius of Attack Area less than or equal to 1 km. Wind Speed more than 10 KPH.

B2-35. Type "B", Case "3". (NOT TO SCALE)

(1) Obtain the location of the attack from the relevant NBC CHEM message(s) and plot it on the map. (Figure B.2 - V).

(2) Draw a circle, radius 2 km, around the center of the attack location. The area within this circle represents the attack area.

(3) Draw a circle, radius 10 km, around the center of the attack location. The area within this circle represents the hazard area.

(4) Prepare and transmit NBC 3 CHEM to those units and installations within the hazard area in accordance with SOPs.

Example NBC 3 CHEM

ALFA/UK/A234/013/C//
DELTA/211605ZAPR1999//
FOXTROT/32UNH431562/EE//
GOLF/OBS/MSL/10/-/-//
INDIA/AIR/NERV/P//
PAPAA/02KM/2-4DAY/010KM/1-2DAY//
PAPAX/211500ZAPR1999/-//
YANKEE/105DEG/8KPH//
ZULU/2/15C/6/-/2//
GENTEXT/NBCINFO/TYPE B, CASE 3//

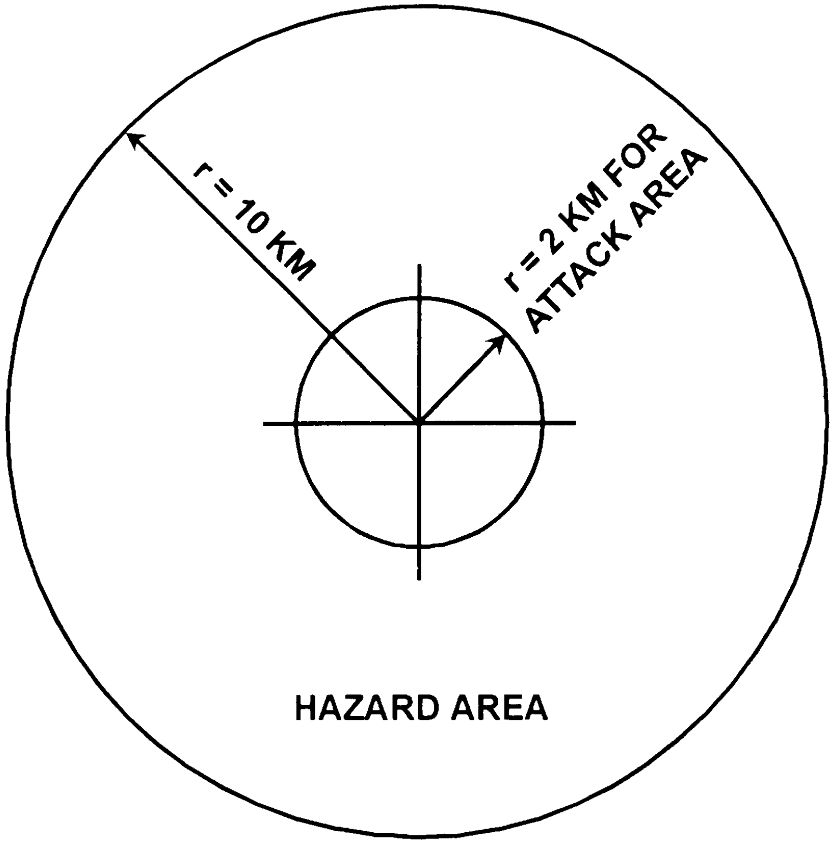


Figure B.2-V, Hazard Area from a Type "B", Case "3".
Attack Area Radius more than 1 km but £ 2 km. Wind Speed £ 10 KPH.

B2-36. Type "B", Case "4". (NOT TO SCALE)

(1) Obtain the location of the attack from the relevant NBC CHEM message(s) and plot it on the map. (Figure B.2 - VI).

(2) Estimate the center of the attack area, and draw a circle, radius 2 km around that center point.

(3) From the center of the attack area, draw a Grid North line (GN Line).

(4) From the center of the attack area, draw a line showing the representative downwind direction.

(5) Plot the 10 km downwind distance from the center of the attack area on the representative downwind line.

(6) From the 10 km downwind distance, draw a line at right angles to the representative downwind direction line. Extend the line either side of the downwind direction line.

(7) Extend the representative downwind line, upwind from the center of the attack area, 4 km. This is equal to twice the radius of the attack area.

(8) From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the 10 km downwind distance line. (See (6) above). These lines will form a 30° angle either side of the representative downwind line.

(9) Using Table B.2 - IV, find the probable time after ground contamination at which personnel may conduct umasking procedures.

(10) Prepare and transmit NBC 3 CHEM to units and installations in the predicted hazard area in accordance with SOPs.

Example NBC 3 CHEM

```
ALFA/UK/A234/006/C//
DELTA/181730ZAPR1999//
FOXTROT/32UNH320010/EE//
INDIA/AIR/NERV/P//
PAPAA/02KM/2-4DAY/10KM/1-2DAY//
PAPAX/181600ZAPR1999/
        32UNH441051/
        32UNH316029/
        32UNH301016/
        32UNG304997/
        32UNG386899//
YANKEE/110DGT/020KPH//
ZULU/4/16C/-/-/2//
GENTEXT/NBCINFO/TYPE B, CASE 4//
```

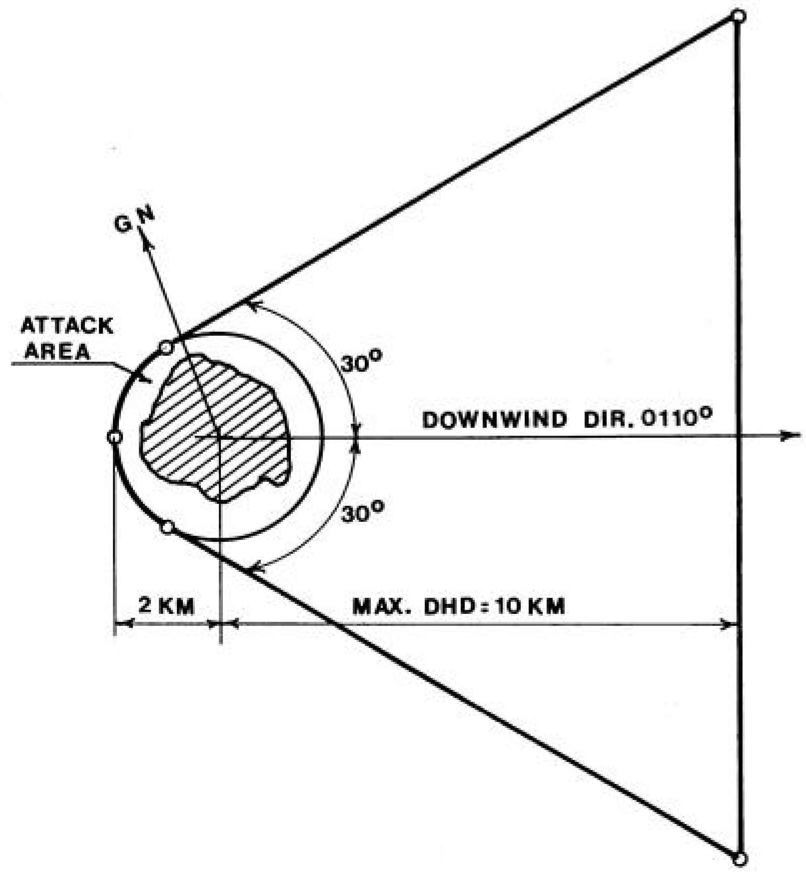


Figure B.2-VI, Hazard Area from Type "B" Attack, Case "4".
Attack Area Radius more than 1 km but less than or equal to 2 km. Wind Speed more than 10 KPH.

B2-37. Type "B", Case "5". (NOT TO SCALE)

(1) Estimate the attack area from a NBC 1 CHEM or NBC 2 CHEM and plot a point at each extreme end.

(2) Connect the end points to form one or more attack lines.

(3) Draw a 1 km radius circle around each end point.

(4) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.

(5) Draw a 10 km radius around each 1 km circle at the end points.

(6) Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the hazard area.

(7) Prepare and transmit NBC 3 CHEM messages to units and installations within the hazard area in accordance with SOPs

Example NBC 3 CHEM
ALFA/UK/A234/014/C//
DELTA/201530ZAPR1999//
FOXTROT/32UNG420620/EE/
32UNG425620/EE//
INDIA/AIR/NERV/P//
PAPAA/01KM/2-4DAY/010KM/1-2DAY//
PAPAX/211500ZAPR1999/-//
YANKEE/147DGT/009KPH//
ZULU/2/15C/6/-/2//
GENTEXT/NBCINFO/TYPE B, CASE 5//

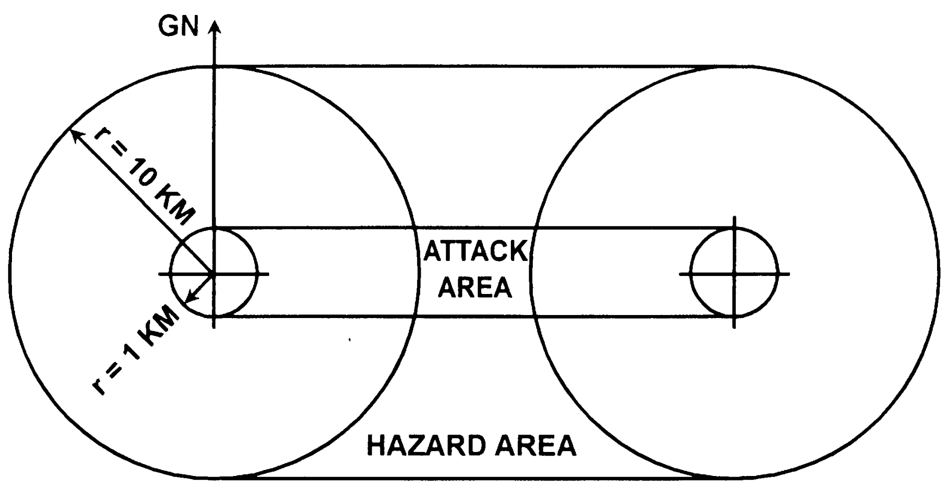


Figure B.2-VII, Hazard Area from Type "B", Case "5".
Any Dimension of Attack Area greater than 2 km. Wind Speed £ 10 KPH.

B2-38. Type "B", Case "6". (NOT TO SCALE)

(1) Estimate the attack area from the NBC 1 CHEM or NBC 2 CHEM and plot it on a map. (Figure B.2 - VIII).

(2) Identify and mark the extremities of the estimated attack area, and connect the end points to form one or more attack lines.

(3) Using the extremities as center points, draw circles, radius of 1 km, around each point. Connect these circles on both sides by drawing tangents to the circles parallel to the attack line, to designate the attack area.

(4) Draw a Grid North line from the center of each circle.

(5) Consider each circle as a separate attack area and carry out the following procedure for each attack area:

(a) From the center of the attack area, draw a line showing the representative downwind direction.

(b) Plot the 10 km downwind distance from the center of the attack area on the representative downwind line.

(c) From the 10 km downwind distance, draw a line at right angles to the representative downwind direction line. Extend the line either side of the downwind direction line.

(d) Extend the representative downwind line, upwind from the center of the attack area, 2 km. This is equal to twice the radius of the attack area.

(e) From the upwind end of this line, draw 2 lines, which are tangents to the attack area circle, and extend them until they intersect with the 10 km downwind distance line. (See (5) (c) above). These lines will form a 30° angle either side of the representative downwind line.

(f) Draw a line connecting the downwind corners of the 2 vapor hazard areas (Points "A" and "B" in Figure B.2 - VIII).

(6) Using Table B.2 - IV, find the probable time after ground contamination at which personnel may conduct umasking procedures.

(7) Prepare and transmit NBC 3 CHEM to units and installations in the predicted hazard area in accordance with SOPs.

Example NBC 3 CHEM

```
ALFA/UK/A234/007/C//
DELTA/141550ZAPR1999//
FOXTROT/33UUC330060/EE/
        33UUC370061/EE//
INDIA/AIR/NERV/P//
PAPAA/01KM/2-4DAY/10KM/1-2DAY//
PAPAX/141400ZAPR1999/
      33UUC482014/
      33UUC374069/
      33UUC368070/
      33UUC328069/
      33UUC320059/
      33UUB326938/
      33UUB366939//
YANKEE/147DGT/012KPH//
ZULU/4/18C/3/-/0//
GENTEXT/NBCINFO/TYPE B, CASE 6//
```

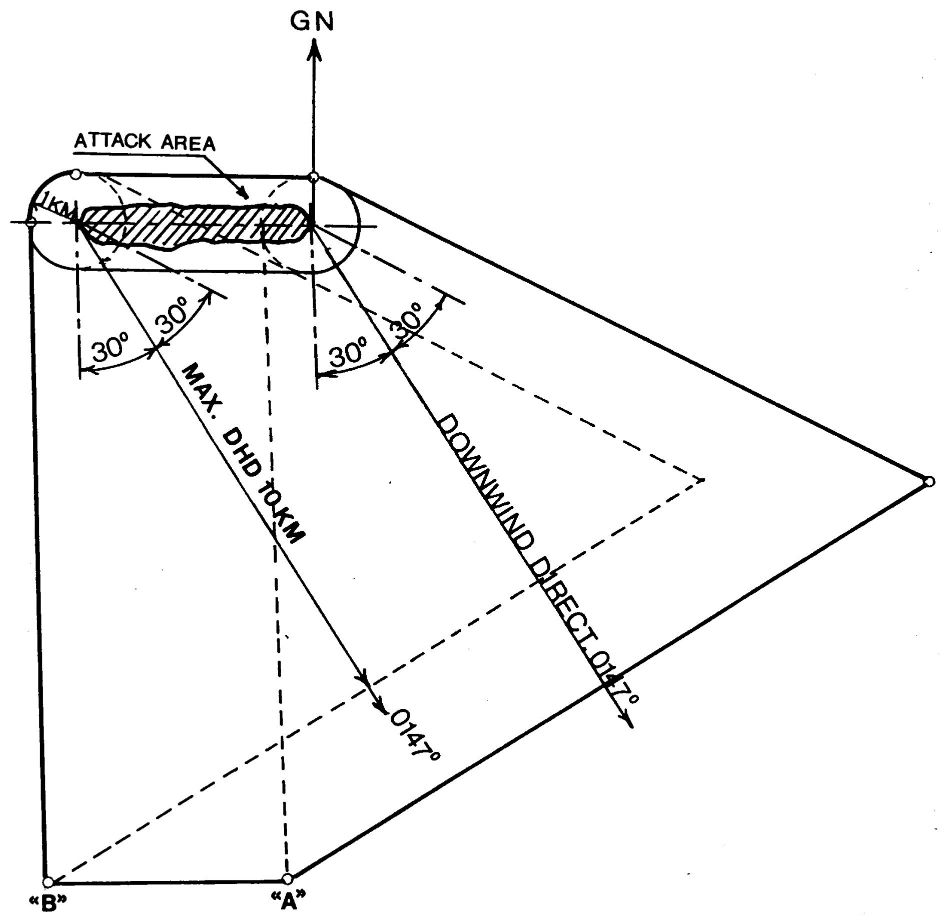


Figure B.2-VIII, Hazard Area from Type "B" Attack, Case "6".
Any Dimension of Attack Area greater than 2 km. Wind Speed more than 10 KPH.

SECTION IX: DETERMINE EARLIEST ARRIVAL TIME OF CHEMICAL CLOUD

B2-39. To estimate the earliest arrival time of the chemical cloud at a certain point, calculate the fastest speed that the leading edge of the chemical cloud will travel by:

Fastest Speed = Downwind Speed x 1.5.

$$\text{Earliest arrival time} = \frac{\text{Distance to point}}{\text{Fastest speed}}$$

The distance to the point considered must be measured from the downwind edge of the attack area.

SECTION X : PROCEDURES FOR RECALCULATION OF PREDICTED DOWNWIND HAZARD AREAS AFTER SIGNIFICANT WEATHER CHANGES.

B2-40. NBC 3 CHEM messages must be revised when significant weather changes are considered to have occurred. These are:

a. A change in the air stability category. This applies only to Type "A" case "2" attacks.

b. The representative downwind direction changes by 30 degrees or more.

c. The representative wind speed:

(1) Changes by 10 KPH or more (Type A, case 2 only).
(2) Increases from less than or equal to 10 KPH to more than 10 KPH.
(3) Decreases from more than 10 KPH to less than or equal to 10 KPH.

NOTE: Should any of the 3 situations above occur, then the downwind hazard plots and the associated NBC 3 CHEM messages must be revised.
Combinations of changes may occur. NBC trained personnel must then find solutions in accordance with the principles listed below.

B2-41. Calculation of the Maximum Downwind Hazard Distances. When significant weather changes occur, or are predicted, the following procedure for type "A" attacks should be used to determine:

(1) The distance the chemical agent cloud will have traveled prior to the change by using:

$$d_1 = u_1 \times t_1$$

d_1 = distance traveled prior to change in weather conditions.

u_1 = representative downwind speed prior to change in weather conditions.

t_1 = time elapsed between the time of attack and the time of the change in weather conditions.

Note: If the distance travelled, as calculated above, is equal to or exceeds the original maximum downwind hazard distance, then recalculation is not required.

(2) The distance the chemical cloud will travel after the change by using:

$$d_2 = H_2 - d_1$$

d_2 = remaining hazard distance.

H_2 = maximum hazard distance under the conditions prevailing after the change.

d_1 = distance traveled prior to change in weather conditions.

Note: In constructing the hazard area, it must be kept in mind that the maximum hazard distance, valid during either set of weather conditions, must not be exceeded. If **d_2** £ **0**, recalculation is not required.

B2-42. Type "A", Case "1" changing to a Type "A", Case "2". (Increase in wind from ≤ 10 KPH to > 10 KPH). (<u>NOT TO SCALE)</u>

(1) Calculate **d_1**.

(2) Draw a circle around the center of the original attack area. Radius **d_1**. The area inside this circle represents the new attack area.

Note: If **d_1** > 10 km then use: **d_1** = 10 km.

(3) From the center of the attack area, draw a line showing the representative downwind direction.

(4) From the center of the attack draw a Grid North line.

(5) From where the representative downwind direction line cuts the new attack area circle, measure and mark the distance **d_2** on the downwind direction line.

(6) From the **d_2** distance, draw a line at right angles to the downwind direction line, and extend it either side of the downwind direction line.

(7) Extend the representative downwind line, upwind from the center of the attack area by **2 x d_1**. This is equal to twice the radius of the new attack area.

(8) From the upwind end of this line, draw 2 lines which are tangents to the new attack area circle, and extend them until they intersect with the right angle line resulting from e.(6).

(9) Prepare and transmit the revised NBC 3 CHEM to units and installations in the new predicted hazard area.

Example NBC CDM
AREAM/NFEA12//
ZULUM/230600ZAPR1999/230900ZAPR1999/
231500ZAPR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/140/008/4/06/8/-/2//
XRAYM/140/012/4/10/8/-/2//
YANKEEM/150/014/4/14/8/-/2//

Example NBC 2 CHEM
ALFA/UK/A234/005/C//
DELTA/231030ZAPR1999//
FOXTROT/32VNH450956/AA//
GOLF/OBS/CAN/-/SHL/24//
INDIA/SURF/NERV/NP//
TANGO/FLAT/SCRUB//
YANKEE/140DGT/008KPH//
ZULUA/4/10C/8/-/2//
GENTEXT/NBCINFO/
TYPE OF AGENT
CONFIRMED BY
CHEMICAL DETECTION
KIT. RECALCULATION
BASED ON CHANGE IN
WIND SPEED 231100Z//

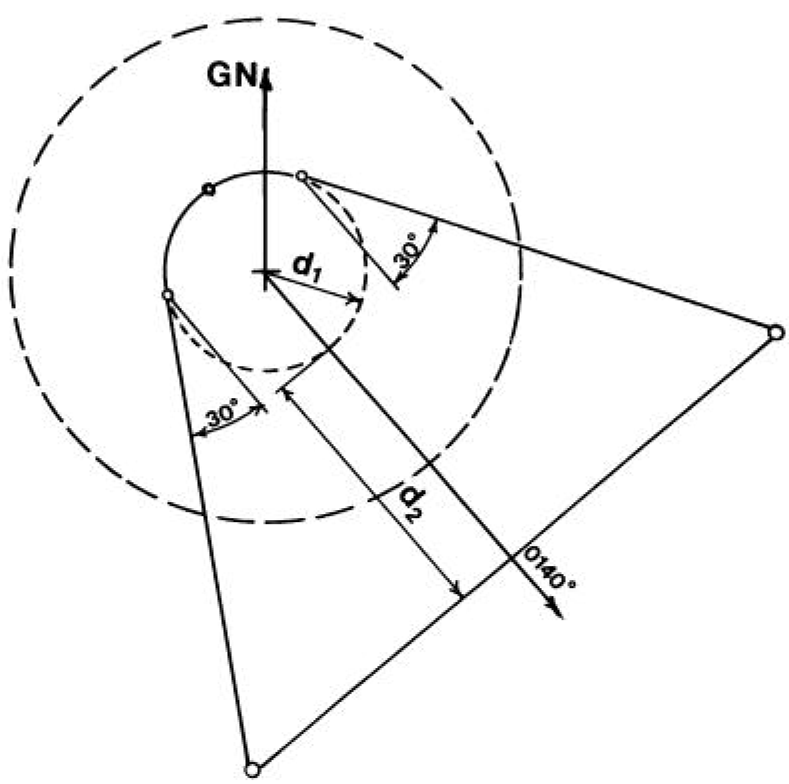


Figure B.2-IX, Recalculation of Downwind Hazard Area.
Type "A" Attack, change in Wind Speed from £ 10 KPH to > 10 KPH.

B2-43. Type "A", Case "2" changing to a Type "A", Case "1". (Decrease in Wind from > 10 KPH to ≤ 10 KPH). <u>(NOT TO SCALE)</u>

Example NBC CDM

AREAM/NFEB43//
ZULUM/281200ZAPR1999/281500ZAPR1999/
282100ZAPR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/090/018/4/14/8/-/2//
XRAYM/090/008/4/10/8/4/2//
YANKEEM/090/006/2/06/8/4/2//

Example NBC 2 CHEM

ALFA/UK/A234/005/C//
DELTA/281615ZAPR1999//
FOXTROT/32UPG387764/AA//
GOLF/OBS/MLR/-/RKT/12//
INDIA/SURF/NERV/NP//
TANGO/FLAT/SCRUB//
YANKEE/090DGT/018KPH//
ZULUA/4/14C/8/-/2//
GENTEXT/NBCINFO/
SYMPTOMS OF NERVE
AGENT POISONING.
RECALCULATION
BASED ON CHANGE IN
WIND SPEED
AS OF 281700Z//

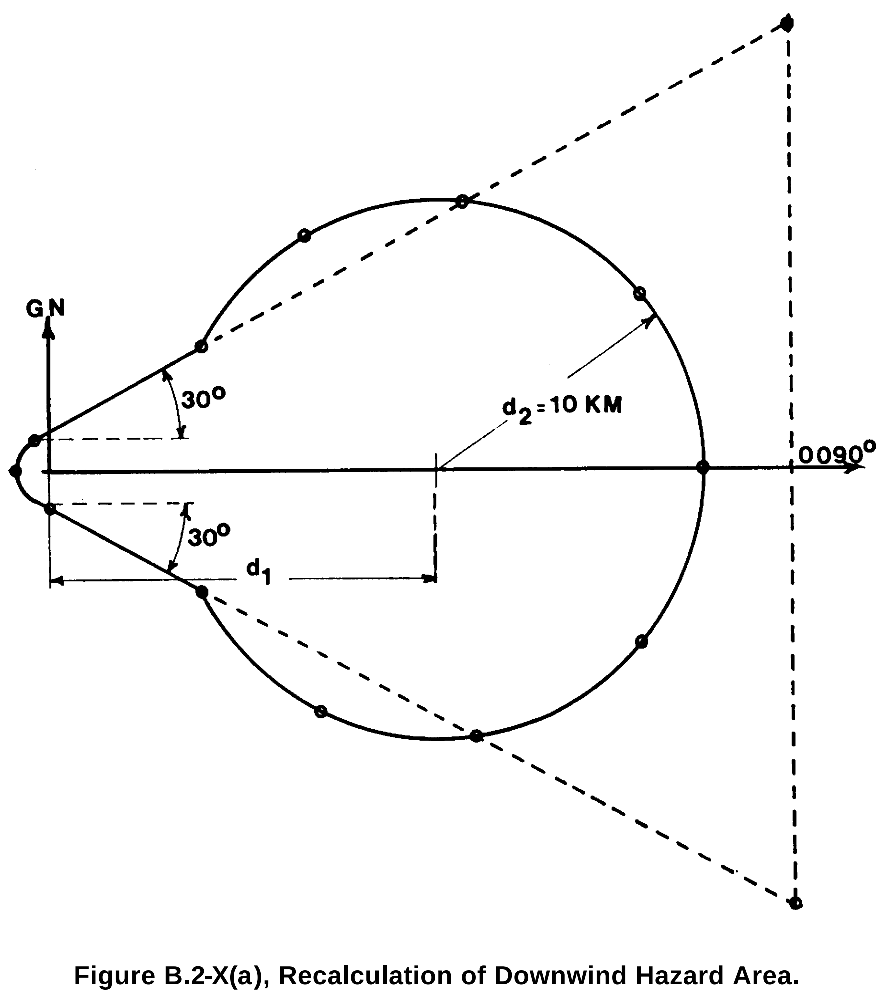


Figure B.2-X(a), Recalculation of Downwind Hazard Area.
Type "A" Attack, change in Wind Speed from > 10 KPH to £ 10 KPH.

Example NBC CDM
AREAM/NFEA12//
ZULUM/280600ZAPR1999/280900ZAPR1999/
281500ZAPR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/120/014/4/06/8/-/2//
XRAYM/120/009/4/10/8/-/2//
YANKEEM/130/007/4/14/8/-/2//

Example NBC 2 CHEM
ALFA/UK/A234/009/C//
DELTA/281030ZAPR1999//
FOXTROT/32UMG892764/AA//
GOLF/OBS/MLR/-/RKT/6//
INDIA/SURF/NERV/NP//
TANGO/FLAT/SCRUB//
YANKEE/120DGT/014KPH/0/
ZULU/4/06C/8/-/2//
GENTEXT/NBCINFO/
RECALCULATION BASED
ON CHANGE IN WIND
SPEED AS OF 281100Z//

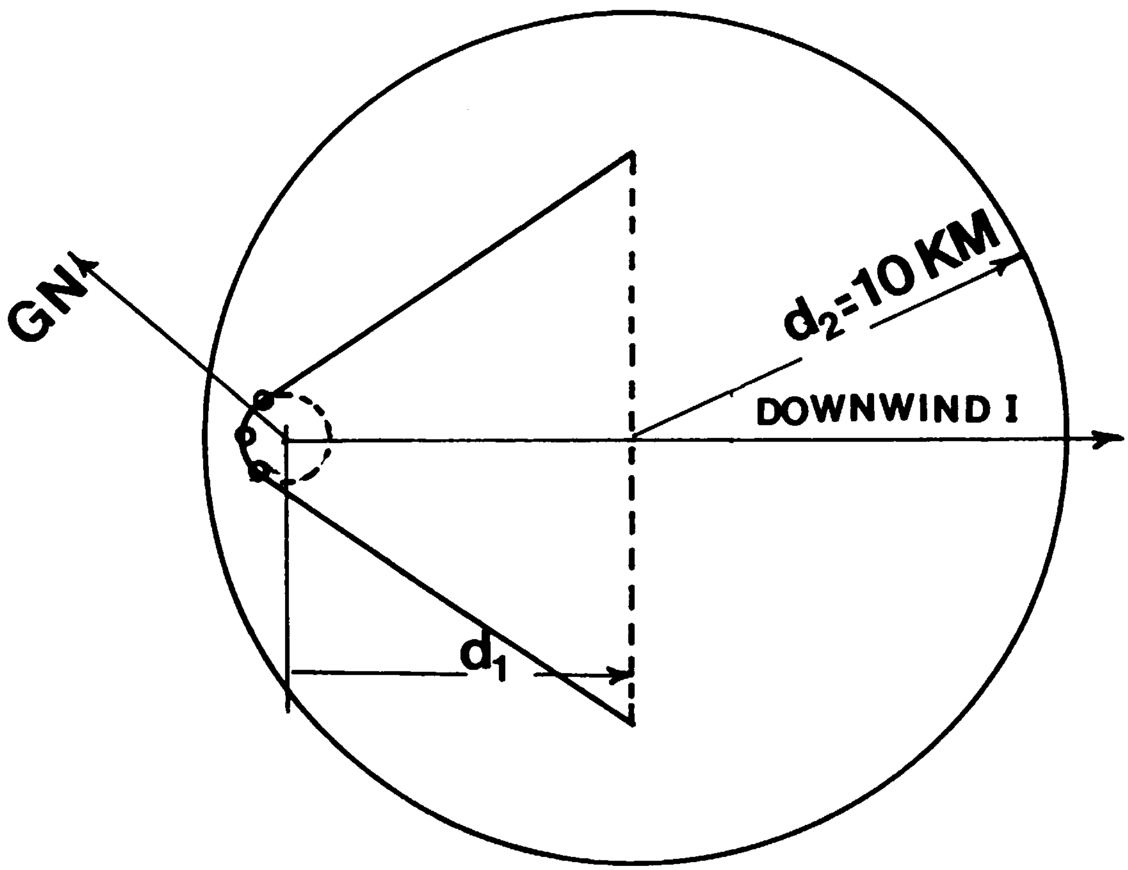


Figure B.2-X(b), Recalculation of Downwind Hazard Area.
Type "A" Attack, change in Wind Speed from > 10 KPH to £ 10 KPH.

Example NBC CDM
AREAM/NFEA12//
ZULUM/280600ZAPR1999/280900ZAPR1999/
281500ZAPR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/120/014/4/06/8/-/2//
XRAYM/120/009/4/10/8/-/2//
YANKEEM/130/007/4/14/8/-/2//

Example NBC 2 CHEM
ALFA/BE/1BDE/013/C//
DELTA/280930ZAPR1999//
FOXTROT/32UMG892764/AA//
GOLF/OBS/MLR/-/RKT/6//
INDIA/SURF/NERV/NP//
TANGO/FLAT/SCRUB//
YANKEE/120DGT/014KPH//
ZULU/4/06C/8/-/2//
GENTEXT/NBCINFO/
RECALCULATION BASED
ON CHANGE IN WIND SPEED
AS OF 281100Z//

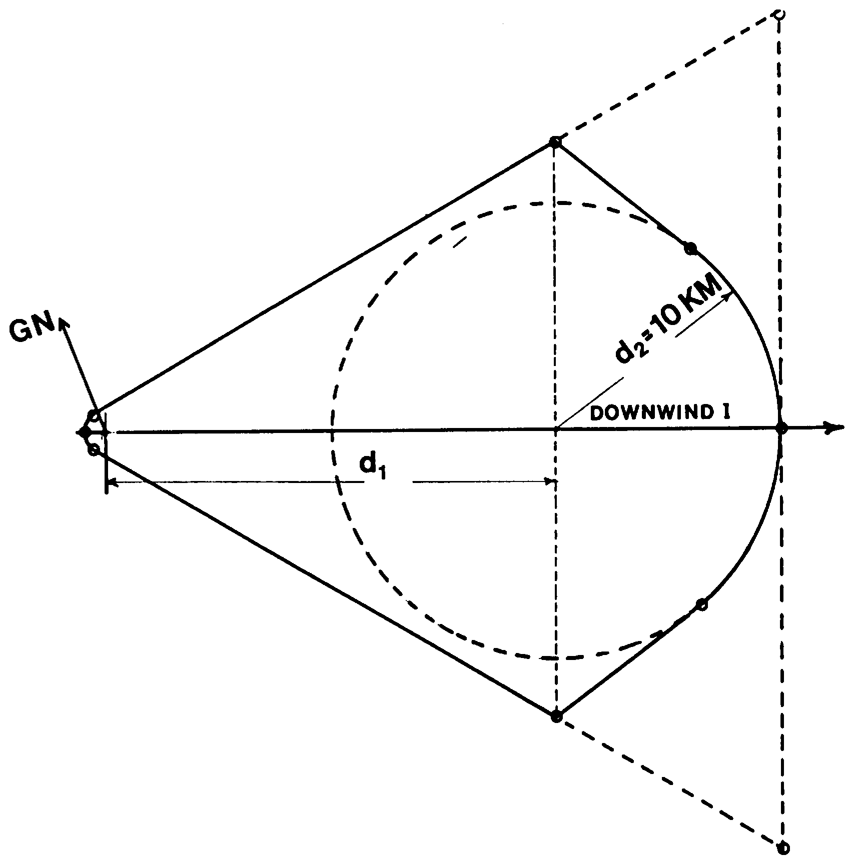


Figure B.2-X(c), Recalculation of Downwind Hazard Area.
Type "A" Attack, change in Wind Speed from > 10 KPH to £ 10 KPH.

(1) Calculate $\mathbf{d_1}$.

(2) From the center of the original attack area measure the distance $\mathbf{d_1}$ along the representative downwind line and mark it.

(3) Using that point as the center, draw a circle with a 10 km radius, until it intersects the two 30° tangents from the original plot. (See Figure B.2 - X(a)).

(4) If the circle does not intersect the tangent lines, draw a line at right angles to the downwind direction line at the $\mathbf{d_1}$ distance and mark the intersections with the tangent lines. From these points draw two new tangents to the 10 km radius circle (See Figure B.2-X(c)).

B2-44. Type "A" Case "2" Attack with a change in the Representative Downwind Direction. (NOT TO SCALE)

Example NBC CDM
AREAM/NFEB43//
ZULUM/280600ZAPR1999/280900ZAPR1999/
281500Z APR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/090/012/2/06/-/-/2//
XRAYM/090/014/2/08/-/-/2//
YANKEEM/140/015/2/08/-/-/2//

Example NBC 2 CHEM
ALFA/UK/A234/010/C//
DELTA/281245ZAPR1999//
FOXTROT/32UNG885419/EE//
GOLF/OBS/MLR/-/RKT/6//
INDIA/SURF/NERV/NP//
TANGO/FLAT/SCRUB//
YANKEE/090DGT/014KPH//
ZULU/2/08C/-/-/2//
GENTEXT/NBCINFO/
CONFIRMED BY
DETECTOR KIT.
RECALCULATION BASED
ON CHANGE IN WIND
SPEED AS OF 281300Z//

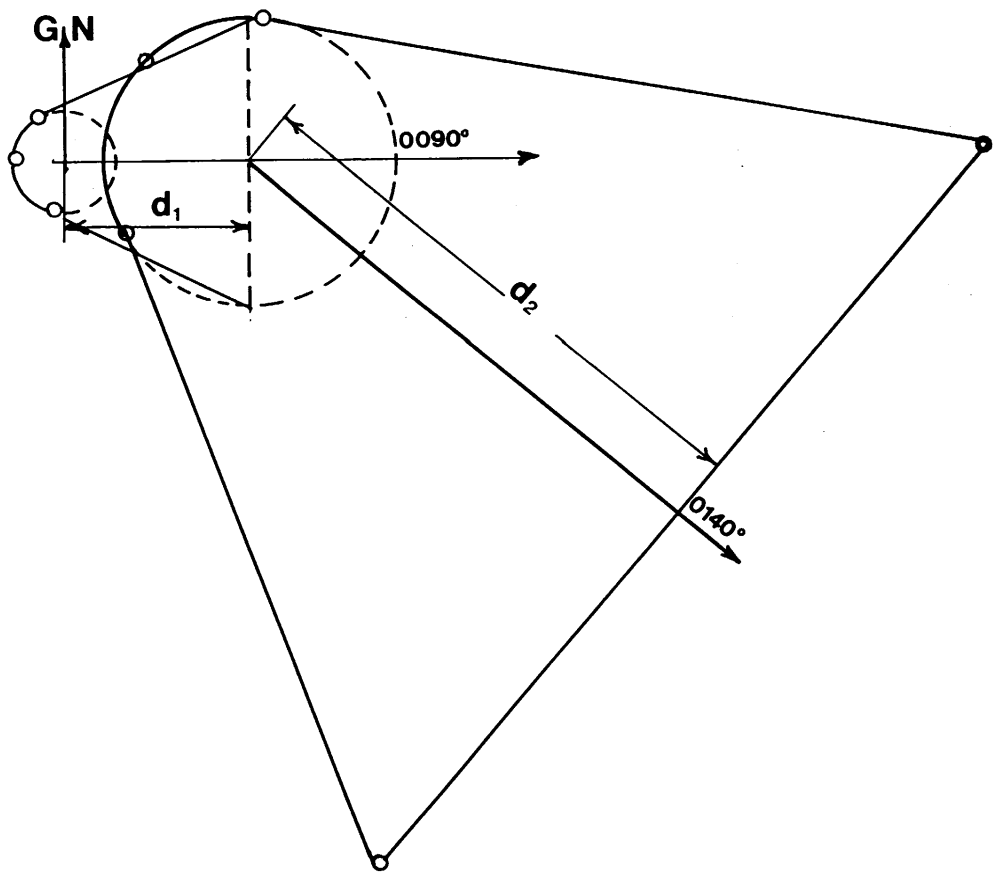


Figure B.2-XI, Recalculation of Downwind Hazard Area.
Type "A", Case "2" Attack, change in Downwind Direction by 30 degrees or more.

(1) Calculate $\mathbf{d_1}$.

(2) From the center of the original attack measure the distance $\mathbf{d_1}$ on the representative downwind line before the change in direction, and mark it.

(3) Draw a line at right angles to the representative downwind line through the point $\mathbf{d_1}$ until it meets the 30 degrees lines from the original plot.

(4) Using the $\mathbf{d_1}$ point as the center, draw a new circle, the radius being the distance from the $\mathbf{d_1}$ point to one of the 30° tangents. The area within this circle is considered to be the new attack area.

(5) From the center of this circle draw a line representing the "new" representative downwind direction.

(6) From the center of this circle measure and mark the $\mathbf{d_2}$ distance on the new representative downwind direction line. If this distance falls within the circle then move it to the perimeter of the circle on the new representative downwind direction line. This will take into account the fact that some of the chemical cloud

may travel at 1.5 times the mean wind speed, and will therefore have traveled further.

(7) Complete the plot by following the procedures in para B.2-22.

B2-45. Type "A" Case "2" Attack with a change in Stability Category or Representative Downwind Speed. (NOT TO SCALE)

Example NBC CDM

AREAM/NFEB34//
ZULUM/280600ZAPR1999/280900ZAPR1999/281500ZAPR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/110/015/6/10/-/4/2//
XRAYM/110/015/6/10/-/4/2//
YANKEEM/110/025/4/10/-/4/2//

Example NBC 2 CHEM

ALFA/UK/A234/012/C//
DELTA/281230ZAPR1999//
FOXTROT/32UPF730750/EE//
GOLF/OBS/AIR/6/BOM/18//
INDIA/SURF/NERV/NP//
TANGO/FLAT/SCRUB//
YANKEE/110DGT/015KPH//
ZULU/6/10C/-/4/2//
GENTEXT/NBCINFO/
RECALCULATION BASED
ON CHANGE IN STABILITY
CATEGORY
AS OF 281300Z//

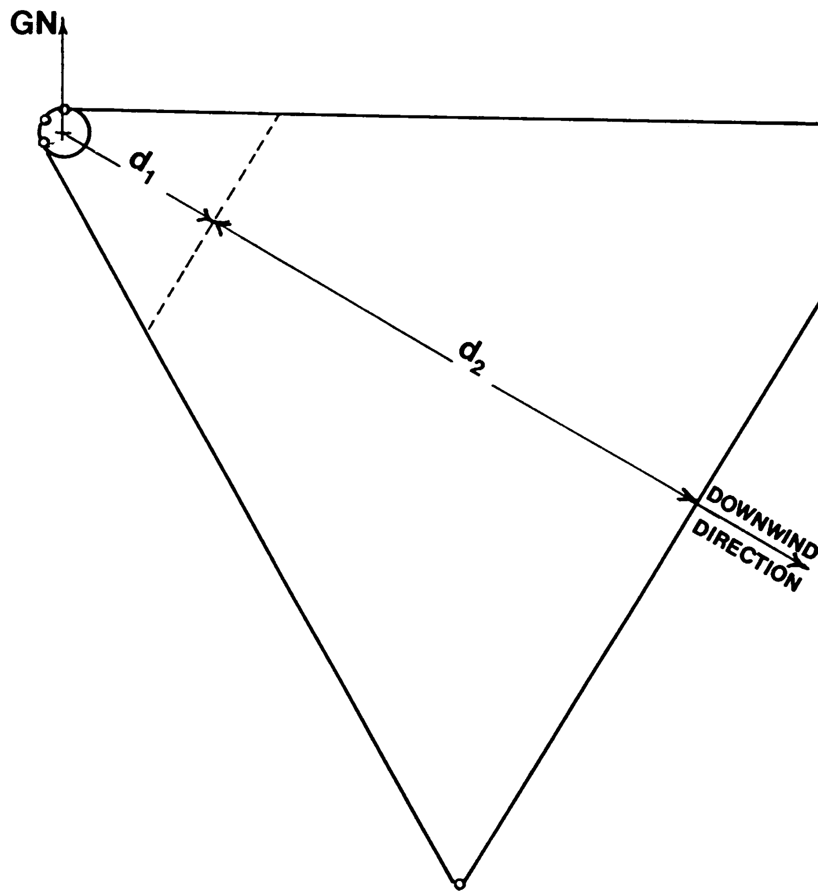


Figure B.2-XII, Recalculation of Downwind Hazard Area.
Type "A", Case "2" Attack. Change in Stability Category and/or Downwind Speed.

B2-46. From the center of the original attack location plot the hazard area as described in para B.2-23.b., using $\mathbf{H_2}$ as the maximum downwind distance.

B2-47. Type "B" Attack, Cases "2" and "4" with a change in Representative Downwind Direction.

(1) From the center of the original attack location, draw the new representative downwind direction line.

(2) Plot the new hazard area as described in paras B-2-24.b. and d., or reposition the template along the new representative downwind direction line and replot. The total area covered by the old **and** the new hazard areas must be considered dangerous until confirmation of the absence of a chemical hazard in the "old" area is received.

B2-48. Type "B" Attack, Case "6"., with a change in Representative Downwind Direction. (NOT TO SCALE)

Example NBC 2 CHEM

ALFA/UK/A234/004/C//
DELTA/281000ZAPR1999//
FOXTROT/32VMH747388/EE//

GOLF/OBS/AIR/-/SPR/-//

INDIA/AIR/NERV/P//

TANGO/FLAT/SCRUB//

YANKEE/090DGT/020KPH//

ZULU/4/18C/8/-/0//

GENTEXT/NBCINFO/SYMPTOMS OF NERVE AGENT POISONING//

Example NBC 3 CHEM

ALFA/UK/A234004/C//
DELTA/281000ZAPR1999//
FOXTROT/32VMH747388/EE/
32VMH897388/EE//
INDIA/AIR/NERV/P//
PAPAA/01KM/96HR/10KM/48HR//
PAPAX/281100ZAPR1999/
32VMH846318/32VMH846329/
32VMH856335/32VMH846341/
32VMH847456/32VMH742396/
32VMH740395/32VMH739394/
32VMH738393/32VMH738392/
32VMH737391/32VMH737389/

32VMH737388/32VMH736266/

32VMH836324/32VMH846318//

YANKEE/090DGT/020KPH//

ZULU/4/18C/8/-/0//

GENTEXT/NBCINFO/

RECALCULATION BASED ON NBC CDM WEATHER CHANGE AS OF 281100Z//

Example NBC CDM

AREAM/NFEA12//
ZULUM/280600ZAPR1999/280900ZAPR1999/
281500ZAPR1999//
UNITM/KM/DGT/KPH/C//
WHISKEYM/090/020/4/18/8/-/0//
XRAYM/150/020/4/18/8/-/0//
YANKEEM/150/020/4/18/8/-/0//

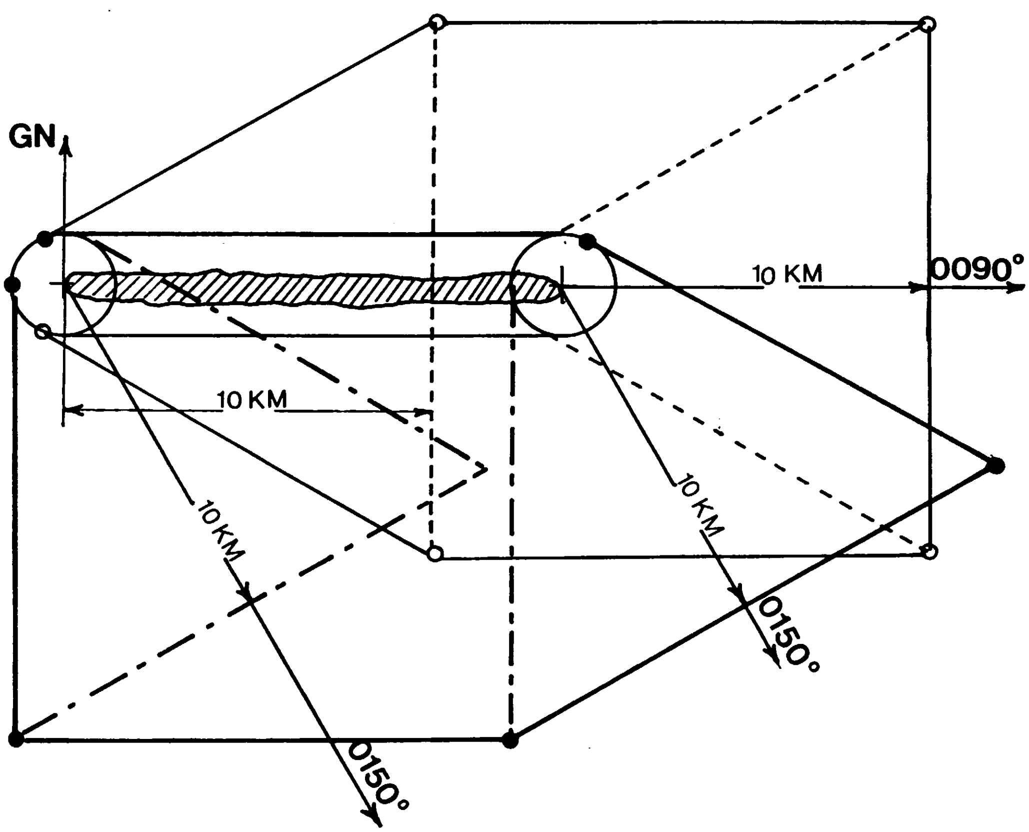


Figure B.2-XIII, Recalculation of Downwind Hazard Area.
Type "B", Case "6" Attack, change in Downwind Direction.

(1) Plot the hazard area as calculated both for before and after the change in wind direction using the procedure described in para B.2-24.f.

(2) In the NBC 3 CHEM indicate in set GENTEXT/NBCINFO the reason for recalculation and the effective time for the new hazard area.

B2-49. Type "B" Attack, Case 2, 4 and 6 with a change in Wind Speed from > 10 KPH to ≤ 10 KPH.

(1) Plot the hazard area as calculated for the wind speed > 10 KPH using the procedure described in para B.2-24.b., d. or f.

(2) Plot the hazard area as calculated for the wind speed ≤ 10 KPH using the procedure described in para B.2-24.a., c. or e.

B2-50. In the examples of the hazard area, which is valid after the change in wind direction, also includes the area before the change. This takes into account transient hazards caused by the shift in wind direction in the areas between the two hazards.

B2-51. When recalculation is completed, calculate the arrival time of the hazard, and issue a NBC 3 CHEM to those who will be affected. Issue the new NBC 3 CHEM to those units initially warned, to inform them that there may be a residual vapor hazard in their area. The same Strike Serial Number should be used as in the previous message and the previous message should be referred to in set GENTEXT/NBCINFO of the new message.

Summary Table.

CHANGES OF:	**A 1**	**A 2**	**B 1**	**B 2**	**B 3**	**B 4**	**B 5**	**B 6**
Wind Speed: By 10 KPH or more	X	X						
From > 10 KPH to ≤ 10 KPH		X		X		X		X
From ≤ 10 KPH to > 10 KPH	X		X		X		X	
Wind Direction: By 30 DEG or more		X		X		X		X
Stability Category:		X						

Morning (AM)			
Sun Elevation Angle	**Condition of sky**		
	Less than half covered	More than half covered	Overcast
< 4°	S	S	N
> 4° - 32°	N	N	N
> 32° - 40°	U	N	N
> 40°	U	U	N

U = Unstable N = Neutral S = Stable

Afternoon (PM)			
Sun Elevation Angle	**Condition of sky**		
	Less than half covered	More than half covered	Overcast
> 46°	U	U	N
> 35° - 46°	U	N	N
> 12° - 35°	N	N	N
> 5° - 12°	S	N	N
< 5°	S	S	N

Table B.2-I, Determination of Stability Category.

Enter with: - Time of day.
- Degree of cloud coverage.
- Sun elevation angle (night less than 4 degrees).

Note 1: The stability category found in this table must be adjusted by using Table B.2-II.

Note 2: The sun elevation table contains basic information. Nations may convert the table into a suitable format for their own use.

Specific ground (terrain) and Weather influences	Stability Category from Table B.2-I		
	U	**N**	**S**
Dry to slightly moist surface.	**U**	**N**	**S**
Wet surface (i.e. after continuous rain) or dew.	**N**	**N**	**S**
Frozen surface or partly covered with snow, ice or hoarfrost.	**N**	**S**	**S**
Surface completely covered with snow.	**S**	**S**	**S**
Continuous rainfall (no shower activity).	**N**	**N**	**N**
Haze or mist (visibility 1 - 4 km).	**N**	**N**	**S**
Fog (visibility less than 1 km).	**N**	**S**	**S**
Downwind speed more than 18 KPH.	**N**	**N**	**N**

Table B.2-II, Stability Category Adjustment.

B2-52. Table B.2-II is used for adjustment of the stability category found from Table B.2-I, taking into account influences of surface and weather. All eight conditions of terrain and weather listed in Table B.2-II must be checked, and in case of doubt the most stable category is to be chosen.

Type of agent container	Distance from center of attack area along downwind axis, when stability condition is:		
	U	**N**	**S**
Shell, Bomblets and Mines. (SHL, BML, MNE)	10 KM	30 KM	50 KM
Air burst Missiles, Bombs, Rockets and Unknown Munitions.	15 KM	30 KM	50 KM

(MSL, BOM, RKT, UNK)			

Table B.2-III, Type "A" Attack Downwind Distance of Hazard Area.

Note: When information is not available concerning the nature of the munitions used in the attack, use the figures given for rocket launchers, missiles and bombs.

Daily mean surface air temperature	Within attack area (number of days)	Within hazard area (number of days)
< 0° - 10° C	3 to 10 days	2 to 6 days
11° - 20° C	2 to 4 days	1 to 2 days
> 20° C	up to 2 days	up to 1 day

Table B.2-IV, Type "B" Attack, probable Time after Ground Contamination at which Personnel may safely remove Masks.

Notes:

1. The estimates assume ground contamination densities up to 1000 mg/m².

2. In making hazard estimates, vapor has been considered to be the determine factor within the attack area as well as in the downwind hazard area. The duration of hazard from contact with bare skin is, however, difficult to predict. The duration can only be determined by the use of chemical agent detection or confirmation devices.

3. When temperatures are considerable low, the duration of contamination may be longer than indicated in the table. The absence of vapor does not preclude the presence of contamination.

4. Daily mean surface air temperature may be obtained from local MET sources.

SECTION XI – CALCULATION OF THE REMAINING HAZARD AREA

Report Formatting Instructions at the NBC Center.

B2-53. In rare cases where a unit is hit by a downwind hazard without being able to identify the attack data needed to report a NBC 1 CHEM, the unit may report the measured data by use of a NBC 4 CHEM. Until detailed procedures are developed for such an off target situation, the responsible NBC Center has to decide the actual course of action, including estimation of the hazard area and the need for warning.

B2-54. Selected units in the contaminated area will be directed to submit additional NBC 4 CHEM reports. The NBC Center uses these reports to evaluate a chemical contamination. For the format used to pass monitoring and survey results see the NBC 4 CHEM report as described in Chapter 2, para 206.

B2-55. Monitoring reports contain the type of agent detected (set INDIA) indicating type of chemical agent and persistency, the location of the sampling (geographical position) and type of sample (air sample, liquid sample or SICA sample) (set QUEBEC), the date-time of the detection and topography information.

Example NBC 4 CHEM

INDIA/-/NERV/P//
QUEBEC/32VNJ481203/AIR//
ROMEO/5MM3//
SIERRA/071600ZFEB1999//
TANGO/FLAT/BARE//

B2-56. If no chemical agent is detected, this should be reported by entering NIL into set INDIA. When all hazards from one attack are gone, the responsible NBC Center should report this in a NBC 4 CHEM by entering NIL into set INDIA, and by entering "CHEMICAL FREE ATTACK" into set GENTEXT/NBCINFO. To be able to identify the attack, the strike serial number (set ALFA from the NBC 2) must be included into the report.

SECTION XII: PLOTTING DATA AND PRODUCING AN NBC 5 CHEM MESSAGE

B2-57. Contaminated areas are shown on the Chemical situation maps, produced in the NBC Centers as a result of NBC 4 CHEM messages. This information must be passed to other units and HQ's. The most expeditious means for this is the chemical contamination overlay. However, facsimile channels of electrical communications are not always available. If this is the case, the chemical contamination overlay must be converted into a series of coordinates for transmission as a NBC 5 CHEM report as in the following example:

Example NBC 5 CHEM

ALFA/BE/1BDE/002/C//
DELTA/071530ZFEB1999//
INDIA/AIR/NERV/P//
OSCAR/071930ZFEB1999//
XRAYA/-/32VNJ575203/32VNJ572200/32VNJ560219/
32VNJ548218/32VNJ540212/32VNJ537206/
32VNJ537193/32VNJ540187/32VNJ548181/
32VNJ560180/32VNJ572188/32VNJ575196/
32VNJ575203//

Annex 3, Appendix B

DETERMINATION OF THE LIKELY HAZARD AREA FOLLOWING

A CHEMICAL ATTACK, AND THE WARNING OF UNITS

WITHIN THE AREA (SEA).

The chemical prediction procedure for sea areas provides information on the location and the extend of the hazard area and the duration of the hazard resulting from attacks with chemical agents at sea and in the coastal region. It provides information necessary for commanders to warn units at sea and on the adjacent land areas.

SECTION I – DEFINITIONS

B.3-1. **Attack Area**. The attack area is the predicted area immediately affected by the delivered chemical agents at sea or on the shoreline. If the location of the attack area is unknown, it is assumed to be located up wind, at a distance equivalent to the unit's maximum range of reconnaissance. The size of the attack area is assumed to be contained within a 0.5 NM radius circle.

B.3-2. **Hazard Area**. The hazard area is the predicted area in which unprotected personnel may be impaired in completing their mission by vapour spreading downwind from the attack area.

B.3-3. The downwind hazard distance depends strongly on the defined hazard.

B.3-4. **Defined Levels of Hazard**. In this publication 3 (three) different levels of hazard may be taken into account: LCt_{50}, ICt_5, and miosis (impaired vision).

B.3-5. The following dosage limits (mg x min/m3) are valid:

Agent	LCt_{50}	ICt_{50}*	ICt_5	Miosis
SARIN	70	35	5	3
SOMAN	70	35	5	3

B.3-6. When preparing a NBC 3 CHEM message for the above listed chemical agents, the NBC agency must always indicate which hazard level the predicted hazard area is based upon. This information should be contained in set GENTEXT.

SECTION II – GENERAL PROCEDURES

B.3-7. **The Horizontal Extent of the Downwind Hazard Area**. The horizontal extent of the downwind hazard area depends on:

- The type of chemical agent.
- The means of delivery (agent concentration in the attack area).
- The meteorological conditions.
- The defined hazard (hazard level).

B.3-8. **The Vertical Extent of the Hazard**. The hazard extends at least up to 150 m above the sea surface in the vertical. Aircrews flying low level must therefore be warned accordingly.

B.3-9. **Chemical Attacks**. Chemical attacks may basically be divided into: Air-contaminating Attacks (Type A attacks), (non-persistent agents), and ground contaminating attacks (Type B attacks), (persistent agents).

B.3-10. Air-contaminating Attacks (Type A attack). In this document, for prediction purposes, two types of air contaminating (non-persistent) agents are recognised:

- Sarin (GB) and all other known non persistent agents, and
- Soman (GD) as an aerosol.

NOTE: If the agent can not be identified, use GB.

B.3-11. Ground-contaminating Attacks (Type B attacks), (persistent agents): Large quantities of persistent chemical agents may be released at sea with the intention of contaminating ship surfaces. For such a situation the procedures in Annex 2 of Appendix B should be used. The resulting hazard area will be over predicted since persistent agent(s) hydrolyze and mix with water and will not generate as much vapor from evaporation as results from land contamination.

SECTION III – MEANS OF DELIVERY

B.3-13. The delivery means are listed bellow:

Delivery System Type

AIR	Aircraft
BOM	Bomb
CAN	Cannon
MLR	Multiple Launched Rocket System
MSL	Missile
MOR	Mortar
PLT	Plant
RLD	Railroad Car
SHP	Ship
TPT	Transport
TRK	Truck or Car
UNK	Unknown

Agent Container Type.

BML	Bomblets
BOM	Bomb
BTL	Pressurised Gas Bottle
BUK	Bunker
CON	Generic Storage Container
DRM	Nominal 200 litre Storage Drum
GEN	Aerosol Generator
MSL	Missile
RCT	Reactor
RKT	Rocket
SHL	Shell
SPR	Spray (tank)
STK	Stockpile
TNK	Storage Tank
TOR	Torpedo
MNE	Mine
UNK	Unknown
WST	Waste

B.3-14. In cases where the means of delivery is unknown, MLR is assumed.

B.3-15. Meteorological Data. The meteorological data required for the downwind hazard area prediction procedure is provided in a NBC Chemical Downwind Message (NBC CDM) (see annex B.2). Valuable MET information can be provided by the attacked unit itself. Therefore units at sea reporting a chemical attack should always attempt to include actual weather information under set YANKEE and ZULU in NBC 1 CHEM or NBC 2 CHEM reports. ZULU may be encoded or in plain text.

B.3-16. **Inversion Layers**. In most cases the concentration of the chemical agent will decrease with increasing height and reach a low concentration (miosis level) at approximately 800 meters. Normally there will be no risk above 3000 meters. Certain meteorological conditions in the atmosphere, known as Inversion Layers, are associated with stable conditions specified in the NBC CDM/NBC CDF under the term "stability category". Stable conditions usually occur at night or in the morning under conditions of clear skies and low wind speed but will also result any time the ground or water surface is cooler than the air above it. An Elevated Inversion layer occurs when the surface inversion layer decays or under unusual advection conditions. With both inversion and elevated inversion layers the concentration of the chemical agent will be higher within the layer than with no inversion. The concentration of the chemical agent will be very small above the layer. If the height of the top of any inversion layer is lower than 800 meters, this will be indicated in the NBC CDM/NBC CDF by the letter "A" appearing in the coded "significant weather phenomena". If the height of the top is lower than 400 meters, letter "B" is to be used, if lower than 200 meters, letter is to be "C". These letters signify the safe altitudes for aircraft to avoid being chemically contaminated.

B.3-17. **Prediction Procedures**. For sea areas, the prediction of chemical downwind hazard areas follows either the simplified procedure (see Section II) or detailed procedure (see Section III).

B.3-18. The simplified procedure is intended for use in ships, whereas the detailed procedure is designed for use in NBC agencies at Naval HQ's, where trained NBC personnel and suitable facilities are available.

SECTION IV – THE SIMPLIFIED PROCEDURE

B.3-19. The simplified procedure requires:

- Sea chart of the area of operation,
- Ship's Chemical Template (Figure B.3-I),
- NBC 1 CHEM or NBC 2 CHEM, and
- NBC CDM.

B.3-20. **Determination of the Hazard Area.** The hazard area is determined as follows:

(1) The center of the attack area (NBC 1 CHEM or NBC 2 CHEM, set FOXTROT) is plotted on the chart. A circle, the radius of which is 0.5 NM is drawn around the center. This circle represents the attack area.(Figure B.3-II).

(2) The template for a simplified chemical hazard area prediction is placed on the chart in such a way that the center point of the template circle coincides with the center of the attack area. The value on the protractor corresponding to the downwind direction given in the NBC CDM must be oriented towards the north on the chart. This position of the template is marked on the chart by using the holes punched in the template along the downwind axis.

(3) The template is then moved back along the downwind axis until the radial lines become tangents to the circle (30 degrees standard). Use the holes punched out along the radial lines to mark the position and connect to the circle, forming tangents.

(4) The maximum downwind hazard distance is then marked on the downwind axis. Through this point a line is drawn perpendicular to the downwind axis, to intersect the tangents. (Figure B.3 - II).

(5) When, in the NBC CDM, light winds are reported (wind speeds of 5 knots or less), the hazard area is represented by a circle concentric to the attack area, with a radius equal to 15 NM.

SECTION V – THE DETAILED PROCEDURE

B.3-21. The Detailed Procedure, Requirements. The detailed procedure for prediction of chemical downwind hazard areas is designed for use at Naval HQ's, and leads to a more accurate prediction than does the simplified procedure. The detailed procedure is based upon the information compiled in the "**C**hemical **P**rediction **D**ata **S**heet" (CPDS) and NBC 1 CHEM or NBC 2 CHEM.

B.3-22. The CPDS (See Annex E, Figure E-II) must be filled in immediately on receipt of a new and updated NBC CDM, and checked on the receipt of a NBC 1 CHEM or NBC 2 CHEM, containing meteorological information in set YANKEE and ZULU.

B.3-23. The delineation of the hazard area resulting from an attack with chemical agents requires information on:

- The chemical agent and means of delivery.
- Location of the attack area as reported in NBC 1 CHEM or NBC 2 CHEM.
- Representative downwind direction of the agent cloud (taken from CPDS).
- Maximum downwind hazard distance(s) related to the appropriate hazard level(s) (LCt_{50} and/or ICt_{5} and/or miosis). (Taken from CPDS).
- Half-sector angle of the hazard area:
  - 35 degrees for wind speeds higher than 5 knots, but less than 10 knots,
  - 20 degrees for wind speeds of 10 knots and more.

B.3-24. For wind speeds equal to 5 knots or less, the hazard area will be circular with radius equal to the downwind hazard distance for 5 knots wind speed. However, the radius should not exceed 15 NM.

B.3-25. Determination of the Downwind Hazard Area. To plot the chemical downwind hazard area on a sea chart or on General Operations Plot, the above information is used in the following way: (See Figure B.3-II).

(1) Plot the location of the attack area. If the exact location (center of the attack) is known, draw a circle around this point with a radius of 0.5 NM. If only a dissemination area is reported, determine the center point of this area and draw a circle around this point, using a radius of 0.5 NM. If the size of the attack area is known to be larger, the radius must be adjusted accordingly.

(2) From the center of the attack area circle draw aline, representing the downwind direction.

(3) Draw two lines which, being tangents to the circle, form an angle equal to the half sector angle on either side of the representative downwind direction (downwind axis).

(4) Label the point on the downwind direction line (downwind axis), thus marking the extend of the downwind hazard distances for the relevant levels of hazard (LCt_{50} and/or ICt_{5} and/or miosis) and draw a line through these points, perpendicular to the downwind axis and intersecting the two tangents. The downwind hazard areas is are contained within this these lines, the tangents and the upwind arc of the attack area circle.

(5) When low wind speeds are reported in the NBC CDM, (wind speed 5 knots or less), draw a circle concentric to the attack area circle, using the relevant downwind hazard distance as the radius. However, the radius should not exceed 15 NM (see Figure B.3 - IV).

B.3-26. Change in Meteorological Conditions. If the meteorological conditions change within the period of duration of the hazard, the predicted hazard area must be adjusted only if:

- The stability category changes from one category to another, and/or
- The wind speed changes by more than 5 knots or from 5 knots or less to more than 5 knots and vice versa, or
- The wind direction changes by more than 20 degrees.

B.3-27. The hazard area is then determined as follows: Calculate the downwind distance which the agent cloud may have travelled at the time the change in the meteorological conditions occurred, by using the representative downwind speed. Consider this point to be the center point of a "new" attack area, and draw a circle around it with a radius equal to half the width of the hazard area at that point. The distance, which the agent cloud may already have travelled, must be subtracted from the maximum downwind hazard distance under the new weather conditions. (Figure B.3-V).

B.3-28. Agent Clouds crossing the Coast Line. When a cloud from a chemical agent crosses the coast line from sea to land or vice versa, consider the point where the downwind direction line (downwind axis) intersects the coast line to be the center point of a "new" attack area, and follow the procedure described in paragraph B.3-27 above, using the appropriate tables for sea and land to determine the downwind hazard distances.

B.3-29. When frequent changes occur, use the land procedure when working manually. (Annex B.2).

B.3-30. In the case of air contaminating attacks, the beginning and the end of the hazard at a given point may be determined from:

(1) The representative downwind speed.

(2) The distance of the location from the edge of the attack area.

(3) The beginning and the end of the attack.

(4) The following two formulas are used:

$t_B = (d_A \times 60) / (1.5 \times V_Z)$ or
$t_B = (d_A \times 40) / V_Z$ and
$t_E = (d_B \times 60) / (0.5 \times V_Z)$ or
$t_E = (d_B \times 120) / V_Z = 3 \times t_B$

$\mathbf{t_B}$ = time in minutes from the beginning of the attack to the beginning of the hazard.
$\mathbf{d_A}$ = distance between the location and the downwind leading edge of the dissemination area (in NM).
$\mathbf{d_B}$ = distance between the location and the downwind trailing edge of the dissemination area (in NM).
$\mathbf{V_Z}$ = wind speed in knots. If necessary, the wind speed must be determined as the mean wind speed over several periods of validity of the NBC CDM.
$\mathbf{t_E}$ = time in minutes from the end of the attack to the end of the hazard.

EXAMPLE:
Given: $\mathbf{d_A}$ = 5 NM, $\mathbf{V_Z}$ = 10 knots.
Using the formulas,
$\mathbf{t_B}$ and $\mathbf{t_E}$ are calculated as follows:
t_B = (5 NM x 40) / 10 knots = 20 minutes, and
t_E = (5 NM x 120) / 10 knots = 60 minutes

B.3-31. So, the beginning of the hazard is expected at this location 20 minutes after the beginning of the attack and is expected to end 60 minutes after the end of the attack.

B.3-32. The expected maximum duration of the air-contaminating hazard (i.e.; when the calculated hazard is expected to be completely clear), may be obtained by using the maximum downwind hazard distance as $\mathbf{d_A}$, and calculating $\mathbf{t_E}$ from the formulas in para d. above.

B.3-33. The NBC agency (NBC Collection Center/NBC Sub Collection Center) must continuously check the NBC 3 CHEM messages issued, in order to ensure that any new information (meteorological or NBC) is considered. If necessary, a corrected NBC 3 CHEM message must be transmitted.

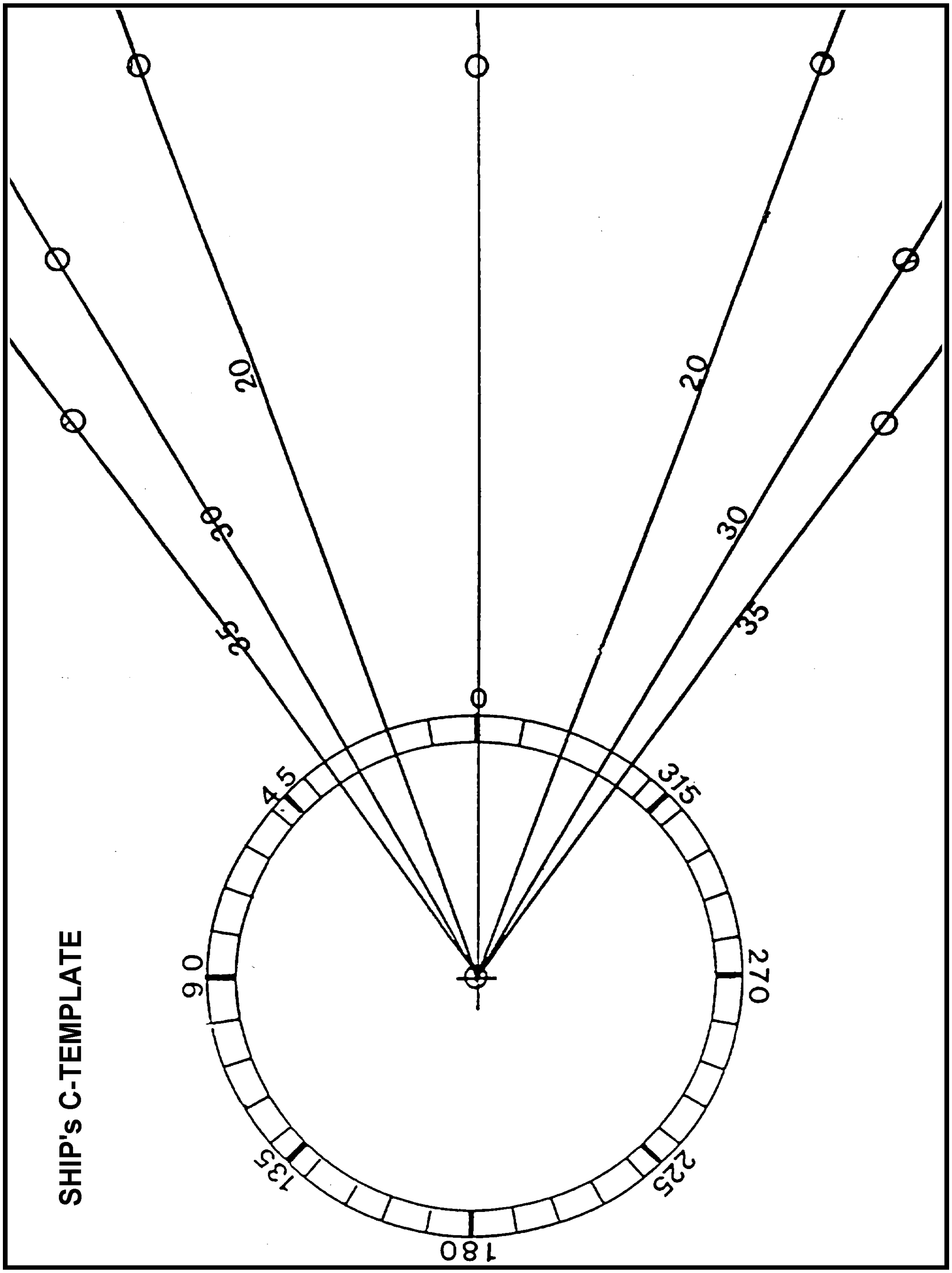


Figure B.3-I, Ship's Chemical Template (example).
Note: The production of the Chemical Template is a national responsibility.

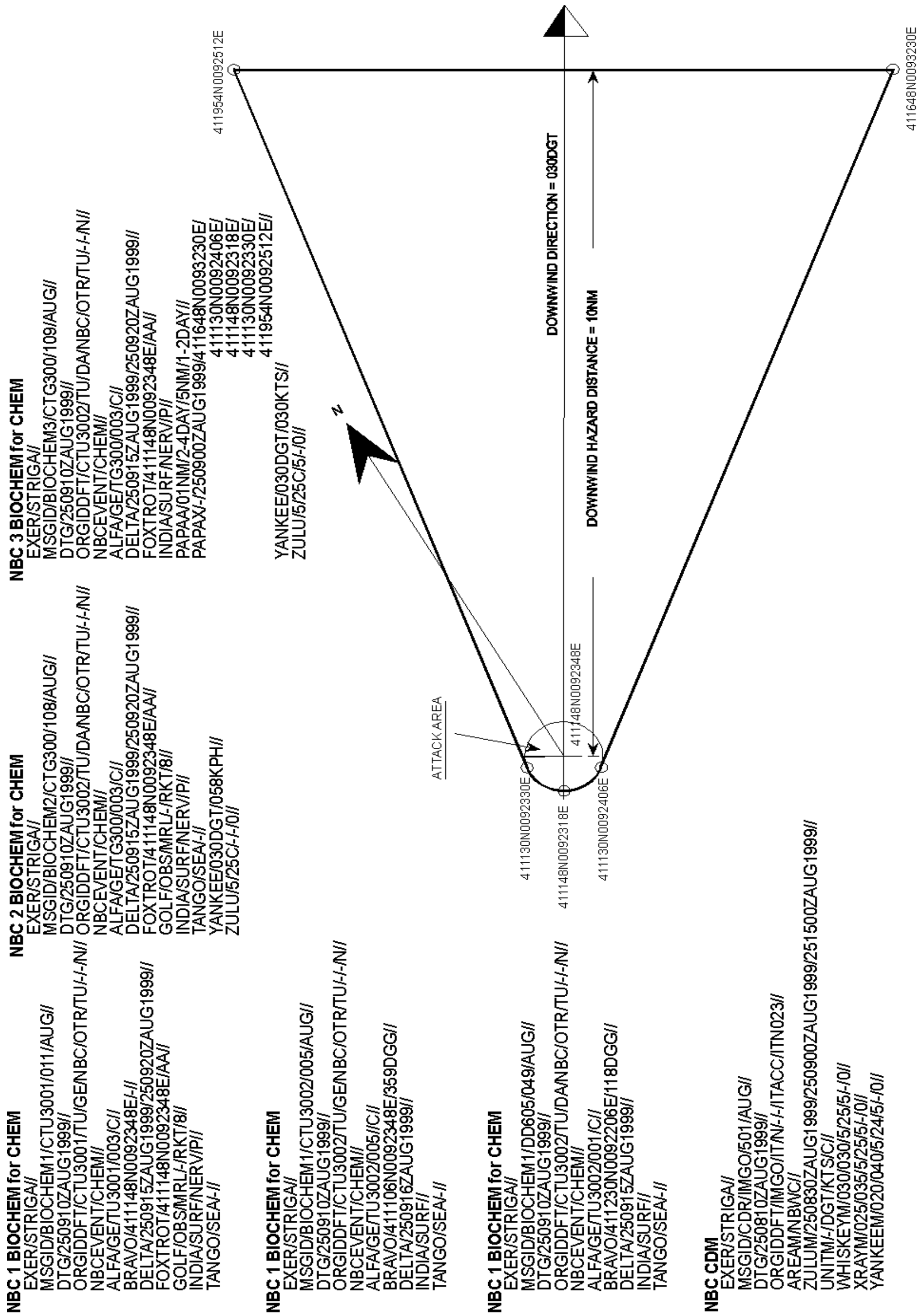


Figure B.3-II, Chemical Downwind Hazard Area Plot.

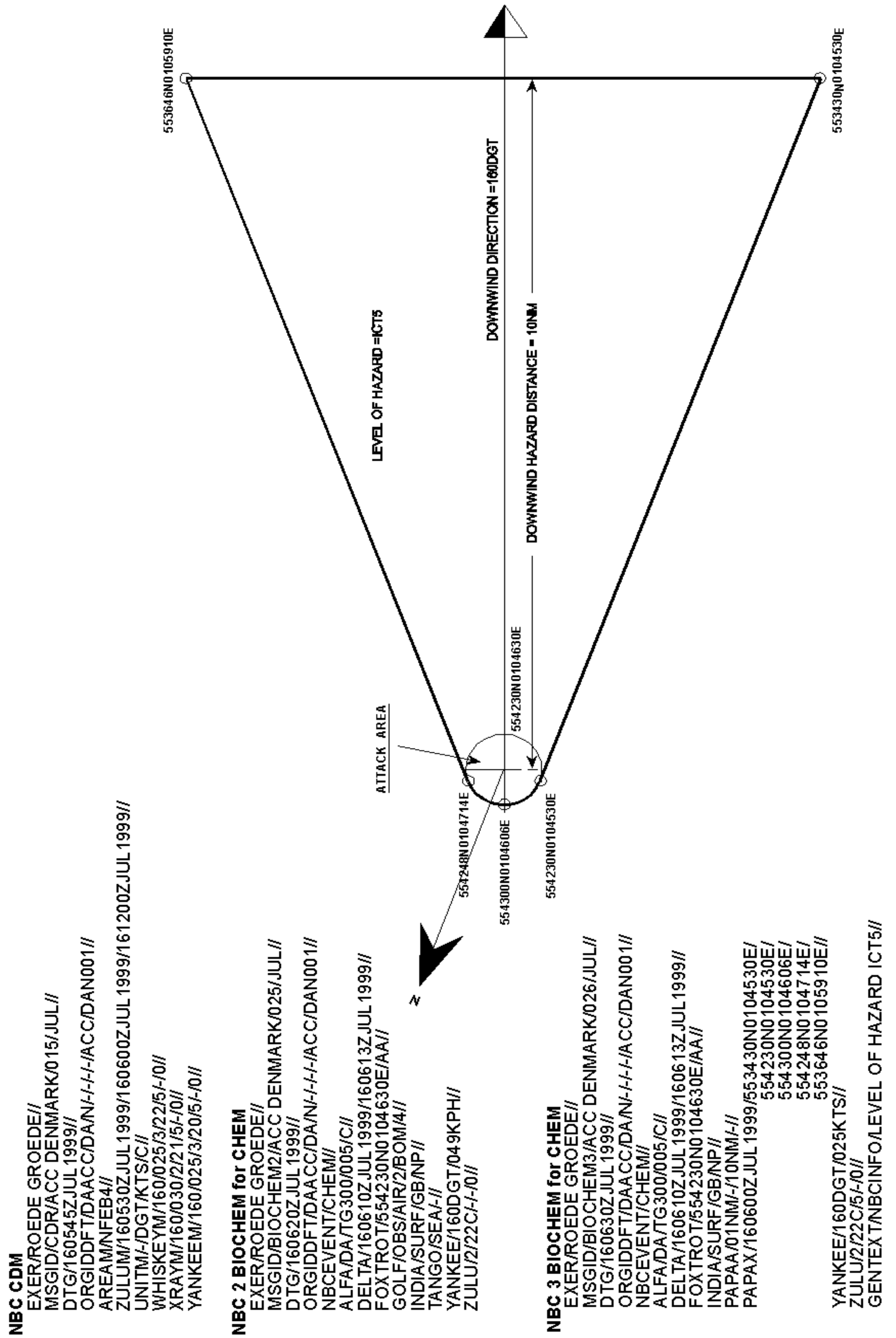


Figure B.3-III, Downwind Hazard Area, Type "A" Attack, Wind Speed 10 knots or more.

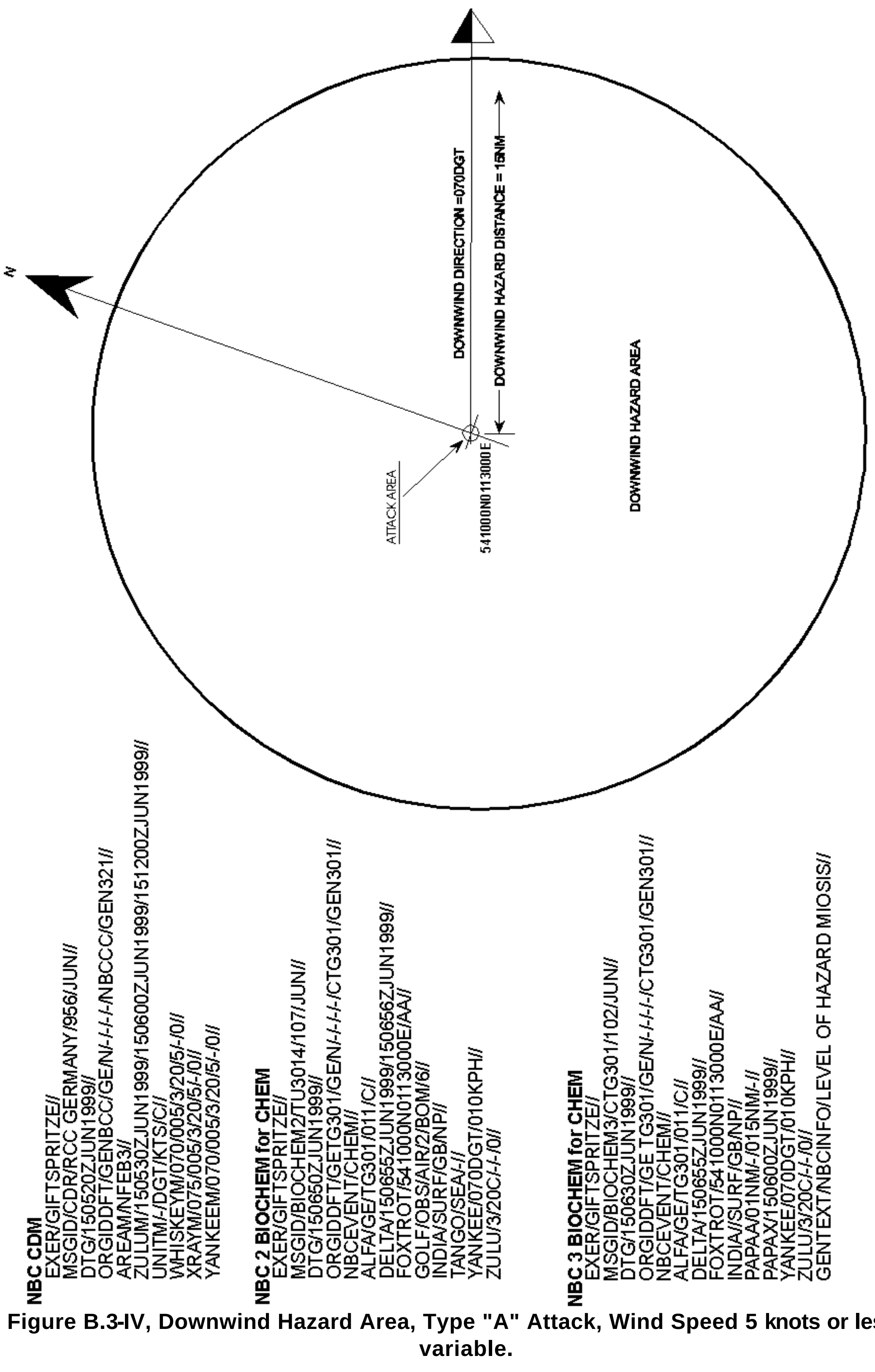


Figure B.3-IV, Downwind Hazard Area, Type "A" Attack, Wind Speed 5 knots or less or variable.

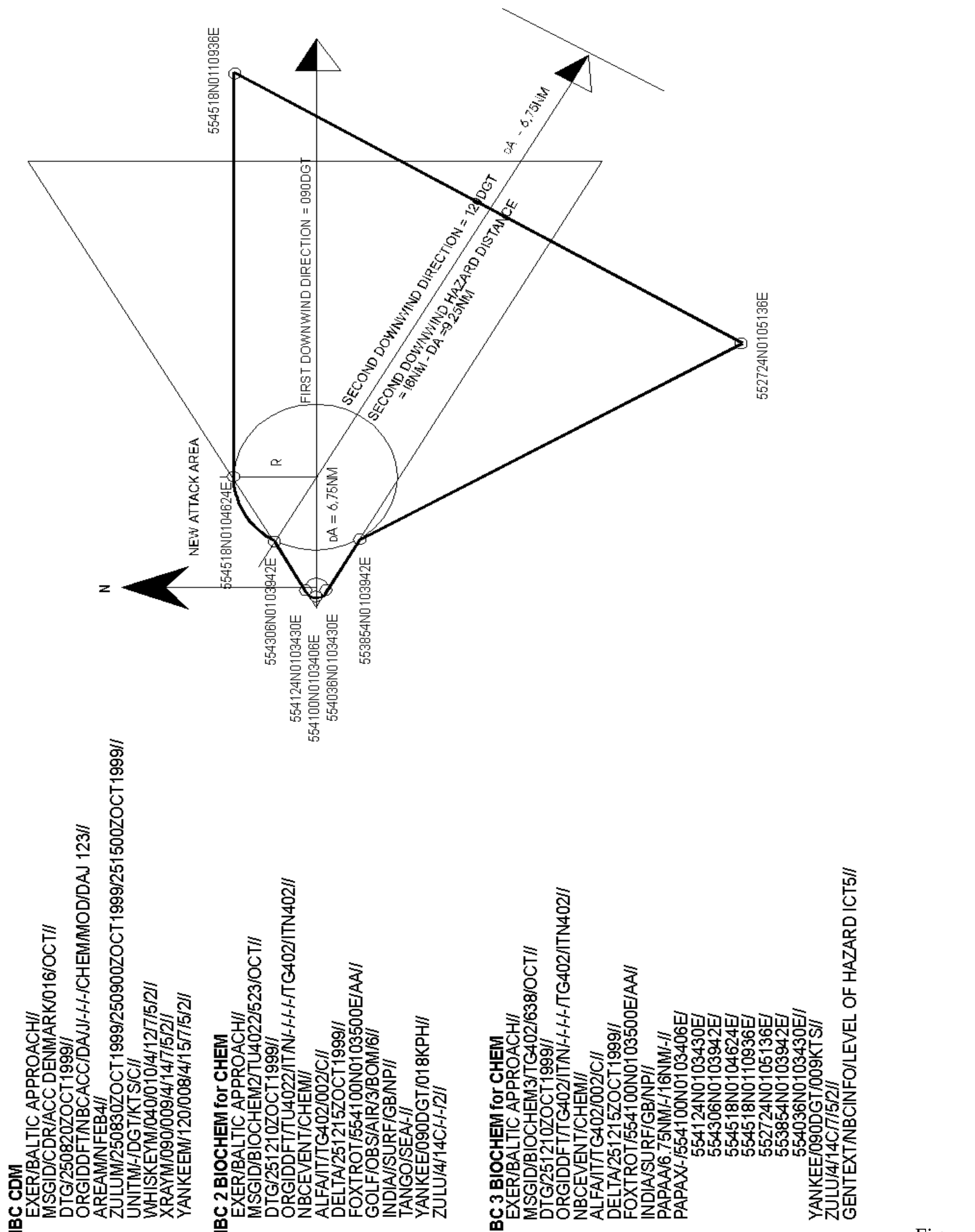


Figure B.3-V, Recalculation of Downwind Hazard Area, Type "A" Attack, after Change in Downwind Direction at Point B.

Annex 4, Appendix B

PREDICTING CHEMICAL HAZARD AREAS

TABLES, GRAPHS ETC.

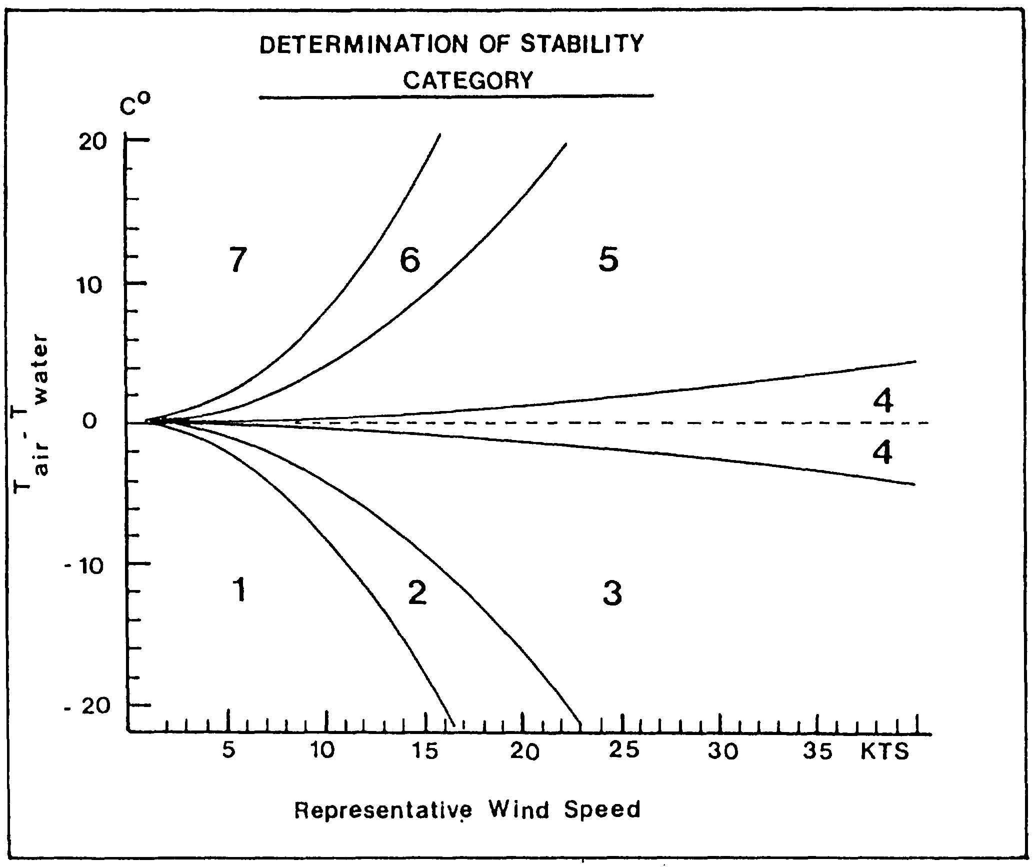


Figure B.4-I, Graph for Determination of Air Stability Category (SEA).

Note: The numbers 1 through 7 in the above graph refer to the seven stability categories.

CDM (ADP formatted)
EXER/CC92//
MSGID/EDR/FLKDOGEOPHYSBLSTN/003/JUN//
AREAM/NFEA//
ZULUM/110400Z/110600ZJUN93/111200ZJUN93//
UNITM/-/DGT/KTS/C//
WHISKEYM/030/005/1/14/7/0/-//
XRAYM/040/010/3/15/6/6/-//
YANKEEM/070/012/4/16/6/6/-//

CHEMICAL PREDICTION SHEET				
Agent:	**Sarin**			
Delivery Means:	**Artillery**			
Hazard Level:	**ICt5**			
1	NBC CENTRE: AMZ BSN			
2	AREA OF VALIDITY: NFEA			
3	ORIGINATOR OF CDM: F1Kdo/GEOPHYS B1St N			
4	DATE: 11 JUN	**PERIOD**		
5	TIME OF VALIDITY: 0600Z - 1200Z	**W**	**X**	**Y**
6	Downwind Direction (Degrees)	030	040	070
7	Representative Downwind Speed 10 m (KTS)	5	10	12
8	1.5 times the Wind Speed (KTS)	7.5	15	18
9	.5 times the Wind Speed (KTS)	2.5	5	6
10	Stability Category	1	3	4
11	Temperature (Centigrade)	14	15	16
12	Relative Humidity (Percent)	70	60	60
13	Significant Weather Phenomena	-	RAIN	RAIN
14	Cloud Coverage	-	-	-
15	Maximum Downwind Hazard Distance (NM)	4	6	6
16	Maximum Duration of Hazard (Hours)	2	1.2	1.2
17	Half Sector Angle (Degrees)	CIRCULAR	20	20
18	Remarks			

Figure B.4-II,
Example Chemical Downwind Message and Chemical Prediction Data Sheet (CPDS).

DOWNWIND HAZARD DISTANCE (KILOMETERS) "LAND"

Agent : SARIN
Weapon ARTILLERY (CANON/MORTAR)
Eff. Payload 650 kg

Agent : SOMAN
Weapon : ROCKET/MISSILE
Eff. Payload : 250 kg

STABILITY	1	2	3	4	5	6	7	DOSE	STABILITY	1	2	3	4	5	6	7	DOSE
WIND	<1	<1	<1	<1	<1	5	5	LCt50	WIND	<1	<1	<1	<1	<1	<1	<1	LCt50
11 – 17	5	5	10	10	15	15	15	LCt5	11 – 17	<1	5	5	5	10	10	10	LCt5
KMH	5	10	10	15	20	25	20	MIOSIS	KMH	5	5	5	10	10	15	10	MIOSIS
WIND	<1	<1	<1	<1	<1	<1		LCt50	WIND	<1	<1	<1	<1	<1	<1		LCt50
18 – 26	5	5	5	10	15	20		LCt5	18 – 26	<1	5	5	5	5	10		LCt5
KMH	5	5	10	15	20	25		MIOSIS	KMH	5	5	5	5	10	15		MIOSIS
WIND		<1	<1	<1	<1			LCt50	WIND		<1	<1	<1	<1			LCt50
27 – 36		5	5	10	10			LCt5	27 – 36		<1	5	5	5			LCt5
KMH		5	10	10	15			MIOSIS	KMH		5	5	5	10			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
37 – 45			5	5	10			LCt5	37 – 45			<1	5	5			LCt5
KMH			5	10	15			MIOSIS	KMH			5	5	5			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
46 – 54			5	5	10			LCt5	46 – 54			<1	5	5			LCt5
KMH			5	10	15			MIOSIS	KMH			5	5	5			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
55 – 63			5	5	5			LCt5	55 – 63			<1	5	5			LCt5
KMH			5	10	10			MIOSIS	KMH			5	5	5			MIOSIS

Table B.4 - I,
Downwind Hazard Distance versus Wind Speed (KM/H) and Air Stability, LAND.

Agent : SARIN
Weapon : BOMBS (6)
System
Eff. Payload : 600 kg

Agent : SARIN
Weapon : Multiple Launched Rocket
Eff. Payload : 3500 kg

STABILITY	1	2	3	4	5	6	7	DOSE	STABILITY	1	2	3	4	5	6	7	DOSE
WIND	<1	<1	<1	<1	<1	<1	5	LCt50	WIND	<1	5	5	5	10	10	10	LCt50
11 – 17	5	5	10	10	15	15	15	LCt5	11 – 17	10	20	25	40	50	45	35	LCt5
KMH	5	10	10	15	20	20	20	MIOSIS	KMH	15	25	40	55	65	60	45	MIOSIS
WIND	<1	<1	<1	<1	<1	<1		LCt50	WIND	<1	5	5	5	5	10		LCt50
18 – 26	5	5	5	10	15	15		LCt5	18 – 26	10	15	25	35	50	55		LCt5
KMH	5	5	10	15	20	25		MIOSIS	KMH	15	20	35	50	70	75		MIOSIS
WIND		<1	<1	<1	<1			LCt50	WIND		<1	5	5	5			LCt50
27 – 36		5	5	10	10			LCt5	27 – 36		10	20	30	40			LCt5
KMH		5	10	10	15			MIOSIS	KMH		15	25	40	50			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	5	5			LCt50
37 – 45			5	5	10			LCt5	37 – 45			15	25	35			LCt5
KMH			5	10	15			MIOSIS	KMH			25	35	55			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	5	5			LCt50
46 – 54			5	5	10			LCt5	46 – 54			15	20	30			LCt5
KMH			5	10	10			MIOSIS	KMH			20	30	45			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	5	5			LCt50
55 – 63			5	5	5			LCt5	55 – 63			10	20	30			LCt5

KMH			5	5	10			MIOSIS	KMH			20	25	40			MIOSIS

Table B.4- II,
Downwind Hazard Distance versus Wind Speed (KM/H) and Air Stability, LAND
DOWNWIND HAZARD DISTANCE (NAUTICAL MILES) "SEA"

Agent : SARIN
Weapon : ARTILLERY (CANON/MORTAR)
Eff. Payload : 650 kg

Agent : SOMAN
Weapon : ROCKET/MISSILE
Eff. Payload : 250 kg

STABILITY	1	2	3	4	5	6	7	DOSE	STABILITY	1	2	3	4	5	6	7	DOSE
WIND	<1	<1	<1	<1	<1	2	2	LCt50	WIND	<1	<1	<1	<1	<1	<1	<1	LCt50
5 – 9	4	4	6	8	8	10	8	LCt5	5 –9	2	2	2	4	4	4	4	LCt5
KTS	4	6	8	10	12	12	12	MIOSIS	KTS	2	4	4	4	6	6	6	MIOSIS
WIND	<1	<1	<1	<1	<1	2		LCt50	WIND	<1	<1	<1	<1	<1	<1		LCt50
10 – 14	2	4	6	6	8	10		LCt5	10 – 14	2	2	2	2	4	4		LCt5
KTS	4	6	8	10	12	14		MIOSIS	KTS	2	2	4	4	6	8		MIOSIS
WIND		<1	<1	<1	<1			LCt50	WIND		<1	<1	<1	<1			LCt50
15 – 19		2	4	6	6			LCt5	15 – 19		2	2	2	2			LCt5
KTS		4	6	8	10			MIOSIS	KTS		2	2	4	4			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
20 – 24			4	4	6			LCt5	20 – 24			2	2	2			LCt5
KTS			4	6	8			MIOSIS	KTS			2	2	4			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
25 – 29			2	4	4			LCt5	25 – 29			2	2	2			LCt5
KTS			4	6	8			MIOSIS	KTS			2	2	4			MIOSIS
WIND			<1	<1	<1			LCt50	WIND			<1	<1	<1			LCt50
30 – 34			2	4	4			LCt5	30 – 34			2	2	2			LCt5
KTS			4	4	6			MIOSIS	KTS			2	2	2			MIOSIS

Table B.4 - III,
Downwind Hazard Distance versus Wind Speed (KTS) and Air Stability, SEA

Agent : SARIN
Weapon : BOMBS (6)
Eff. Payload : 600 kg

Agent : SARIN
Weapon : Multiple Launched Rocket System
Eff. Payload : 3500 kg

STABILITY	1	2	3	4	5	6	7	DOSE	STABILITY	1	2	3	4	5	6	7	DOSE
WIND	<1	<1	<1	<1	<1	2	2	LCt50	WIND	2	2	2	4	4	4	4	LCt50
5 – 9	4	4	6	6	8	8	8	LCt5	5 – 9	12	16	20	26	28	26	20	LCt5
KTS	4	6	8	10	12	12	10	MIOSIS	KTS	16	22	30	36	38	34	26	MIOSIS
WIND	<1	<1	<1	<1	<1	2		LCt50	WIND	2	2	2	2	4	4		LCt50
10 – 14	2	4	4	6	8	10		LCt5	10 – 14	10	14	20	26	30	32		LCt5
KTS	4	6	8	10	12	14		MIOSIS	KTS	16	20	28	38	44	42		MIOSIS
WIND		<1	<1	<1	<1			LCt50	WIND		2	2	2	2			LCt50
15 – 19		2	4	4	6			LCt5	15 – 19		10	16	20	26			LCt5

KTS	4	6	8	10	MIOSIS	KTS	16	22	30	38	MIOSIS
WIND		<1	<1	<1	LCt50	WIND		2	2	2	LCt50
20 – 24		2	4	6	LCt5	20 – 24		12	18	22	LCt5
KTS		4	6	8	MIOSIS	KTS		18	26	34	MIOSIS
WIND		<1	<1	<1	LCt50	WIND		2	2	2	LCt50
25 – 29		2	4	4	LCt5	25 – 29		10	14	20	LCt5
KTS		4	6	6	MIOSIS	KTS		16	22	30	MIOSIS
WIND		<1	<1	<1	LCt50	WIND		2	2	2	LCt50
30 – 34		2	2	4	LCt5	30 – 34		10	12	18	LCt5
KTS		4	4	6	MIOSIS	KTS		14	20	28	MIOSIS

Table B.4- IV,
Downwind Hazard Distance versus Wind Speed (KTS) and Air Stability, SEA.

Appendix C

ROTA TTP

This appendix covers the manual procedures to warn and report NBC releases other than the "traditional" military NBC attacks resulting from offensive use of NBC weapons. These releases, referred to as Releases Other Than Attack (ROTA), may include, but are not limited to, NBC releases due to damaged or destroyed storage bunkers, transport vehicles, storage or production facilities, ammunition supply sites, power plants, etc.

SECTION I - GENERAL

C-1. Every nation in the world has some form of hazardous chemical and biological production or storage facility. Most of these materials are used for peaceful purposes and are considered to be in one of the following categories:

- Agricultural – including insecticides, herbicides, fertilizers…, etc.
- Industrial – chemicals used in manufacturing processes or for cleaning.
- Production and Research – chemicals (as well as biological materials) used in research or are produced in a facility.

C-2. Damage or destruction of a facility or storage site; or any act that creates the unexpected release of civilian chemical products into the environment will present unique challenges to U.S. and allied Armed Forces, as well as the citizens of the Host Nation (HN). Once released, these hazards may cause immediate or delayed incapacitation or death. To safeguard friendly forces and civilians from the potential hazards, peacetime and tactical chemical contamination avoidance principles must be carefully blended.

C-3. Civilian chemical compounds may not be detectable by the standard chemical detection devices of tactical units (see Chapter 2 description of these devices). Civilian compounds may not be detectable with the human senses and may cause symptoms that are different than those symptoms from warfare chemicals.

C-4. To minimize the effects or hazards resulting from the damage or destruction of a chemical or biological facility, prior planning must occur. When friendly units are required to operate in an area where such a facility exists, the operations staff must:

- Coordinate, with the HN emergency response teams. These teams may be from the HN government, armed forces or from the facility itself.

- Identify what chemical or biological material is present, what type of contamination hazard is present, and how far will the contamination hazard extend.
- Determine whether standard chemical detectors will work to detect the threat TIC
- Determine whether standard Chemical Defense Equipment (e.g. protective mask, boots, suit, gloves) will protect against the potential harmful effects of released compounds.
- Coordinate with Divisional Chemical for technical assistance.
- Coordinate with higher headquarters and HN to identify the availability of CAIRA (Chemical Accident/Incident Response and Assistance) teams Technical Escort units or similar civilian agencies available to assist if required.
- Establish warning and evacuation procedures for noncombatants.
- Evaluate options and procedures for protection in place should evacuation not be possible (i.e. hospitals and schools). Procedures and required equipment for protection in place are outlined in FM 3-11.21, Multiservice Tactics, Techniques and Procedures for Nuclear, Chemical, and Biological Aspects of Consequence Management, April 2000.
- Identify a chain-of-command for supervision and coordination of the clean-up effort.
- In the event civilian compounds are released the following steps should be taken immediately by the tactical units within the area:
  - Notify higher, lower, and adjacent units.
  - Start continuous monitoring with available detection equipment. Assume MOPP4.
  - Base hazard predictions on the procedures contained in the

SECTION II – DETERMINATION OF THE LIKELY HAZARD AREA

The following paragraphs cover the manual procedures to warn and report NBC releases other than the "traditional" military NBC attacks resulting from offensive use of NBC weapons. These releases, referred to as Releases Other Than Attack (ROTA), may include, but are not limited to, NBC releases due to damaged or destroyed storage bunkers, transport vehicles, storage or production facilities, ammunition supply sites, power plants, etc.

SECTION III - DEFINITIONS

C-5. RELEASE AREA. This is the predicted area immediately affected by the release.

C-6. HAZARD AREA. This is the predicted area in which unprotected personnel may be affected by NBC material spreading downwind from the RELEASE AREA. The downwind distance depends on the type of release and the weather and terrain in both the RELEASE AREA and the area downwind of the RELEASE AREA.

C-7. CONTAMINATED AREA. This is the area in which NBC material may, in solid or liquid form, remain at hazardous levels for some time after the release. The actual shape and duration can only be determined by surveys.

C-8. ELEVATED RELEASES. Any release which, due to fire, momentum, or explosion, is carried greater than 25 m above the ground is considered an elevated release.

C-9. TOXIC INDUSTRIAL MATERIALS (TIM). A generic term for toxic or radioactive compounds in solid, liquid, aerosolised or gaseous form. These may be used, or stored for use, for industrial, commercial, medical, military or domestic purposes. TIM may be chemical, biological or radioactive and may be described as Toxic Industrial Chemicals (TIC), Toxic Industrial Biologicals (TIB) or Toxic Industrial Radiologicals (TIR).

SECTION IV – TYPES AND CASES OF ATTACKS

C-10. Present in any area of operation there may be chemical, biological, and/or radiological material, which will present a hazard to persons if released into the atmosphere. Releases may be accidental or intentional. The amount of material released may be small or extremely large. Such ROTA can be divided into 2 cases based on their origin:

a. **Case RNP, ROTA NUCLEAR.** Nuclear material can be released into the atmosphere from the core of a nuclear reactor, which has been damaged or which has gone out of control. Similar incidents may occur at nuclear fuel reprocessing or production facilities. Such a release can result in very high levels of radiation covering distances of hundreds of km.

b. **Case TIM, TOXIC INDUSTRIAL MATERIALS.** There are four sub cases of incidents under CASE TIM. These sub cases include items that may be used, or stored for use, for industrial, commercial, medical, military or domestic purposes. TIM may be chemical, biological or radioactive.

(1) **NUCLEAR WASTE, RADIOLOGICAL DISPERSION OR RADIOLOGICAL MATERIAL STORAGE.** Damage to a nuclear or radiological material storage facility may result in release of radiological material into the atmosphere. Such a release will result in low level radiation covering a fairly short distance of danger to anyone remaining in the hazard area for extended periods of time. Intentional release of large amounts or radiological material, however, can result in hazard areas extending far downwind.

(2) **BIOLOGICAL BUNKER OR PRODUCTION FACILITY.** Damage to a storage bunker containing biological agents intended for use in biological warfare or to production facilities for such agents containing active agent containers will result in smaller release areas and lower quantities than if they had been dispersed from a weapon. However, due to the toxicity of such agents, and the likelihood of having an

elevated plume, dispersed material may travel downwind for many hours at hazardous levels.

(3) **CHEMICAL STOCKPILE OR TIM TRANSPORT / STORAGE.** Damage to stockpiled munitions containing chemical agents will result in considerably smaller quantities of agent released than intentional use of the munitions, so the downwind hazard area will usually be smaller than for a chemical attack. Damage to containers of Toxic Industrial Material (TIM) being transported by road, rail, or boat can result in large quantities released into the atmosphere. This category also includes small storage quantities. However, the toxicity and stability of these materials will be less than for chemical agents, so hazard areas will also be smaller than for a chemical attack.

(4) **BULK CHEMICAL STORAGE.** Toxic industrial chemicals (TIC) are stored in very large (greater than 1500 kg) quantities in large tanks, often under pressure and/or at low temperatures. A catastrophic rupture of such a tank will result in a highly toxic cloud, which usually exhibits dense gas behaviour. Such a cloud will not travel with the wind until after its concentration has been reduced considerably, often when it is below toxic levels. In addition to their toxicity, industrial chemicals are often corrosive, flammable, explosive, or able to react violently with air or water. These hazards may be greater than the immediate toxic effects.

SECTION V – HAZARD PREDICTION METHODS

C-11. Case RNP, Releases of Nuclear Fuel. Material released from a nuclear reactor incident will be mostly or all particles of nuclear fuel. Since the decay of particles from a nuclear reactor accident is different than for nuclear weapon fallout, the procedures used for hazard prediction after nuclear detonations, cannot be used.

C-12. If the bulk of the material is elevated to high altitude, the wind speed and bearing at that height from the NBC BWR or other appropriate meteorological data should be used. If the material extends continuously from near the ground to high elevation, the procedures for an elevated release should be used.

C-13. Case TIM, Releases of Toxic Industrial Materials. Due to the differences in materials and/or release types, hazard prediction methodology must be broken down into four sub cases.

a. **Releases from Nuclear Waste, or Radiological Devices Dispersion or Radiological Material Storage Facilities.** Nuclear and radiological material is usually stored well below ground level, usually in special lead drums contained in concrete shelters. Damage to such a facility may rupture some of the drums and release the radiological material into the atmosphere over an extended period of time. The rate of expulsion will be a function of the mass of material released from the drums, the degree of radioactivity of the material, and the amount of energy added to the storage area. The release area will be very localized, and the hazard area is not expected to be very large. But, the cloud may be toxic at low levels for an extended period of time. An exclusion zone of at least 1 km radius around a suspected radiological hazard should be established.

b. **Releases from Biological Agent Bunkers or Production Facilities.** Storage facilities for biological agents usually consist of underground concrete shelters. These shelters are closer to the ground surface. Damage to such a facility may release some biological material from the shelter into the atmosphere as a jet of biological agent, smoke, dust, and soil. The release area will be localized, and the amount of viable agent dispersed will likely be less than that dispersed from an efficient biological weapon. However, since many biological agents only require a few inhaled organisms to infect a person the downwind distance of the hazard area may still be considerable.

c. **Releases from a Chemical Stockpile or TIM Transport/ Storage.** Incidents involving release of chemical agents from a stockpile of munitions or bulk storage will usually involve only a small number of munitions. In such a case the downwind hazard will be considerably smaller than that predicted using the procedures in Appendix B. In the case of chemical agent release from a large number of munitions or bulk storage of chemical agents, the agent quantity will be sufficient to warrant use of the Appendix B procedures. Because of their lower toxicity and stability, incidental release of Toxic Industrial Material from transport vehicles is expected to affect an area considerably smaller than that predicted using the chemical agent procedures. The procedure to use is determined as follows:

(1) Chemical stockpile or bulk storage mass released exceeds 200 litres (LRG): Use the procedures in Appendix B for the appropriate agent and persistency.
(2) Chemical agent detection with no source observation: Use the reporting procedures in Section IV.
(3) Chemical stockpile mass released is SML, or
(4) Toxic Industrial Material release from a transport vehicle: Use the following procedure adapted from the 2000 North American Emergency Response Guide (NAERG2000, available through the US Government Printing Office and as STANAG 2909).

(a) **RELEASE AREA.** The release area is assumed to be a circle having a radius equal to the ISOLATION distance from the NAERG2000. If NAERG2000 is not available, use the conservative values below. The ISOLATION distance is found by using the 4 digit UN/NA ID number provided in Field 2 of INDIA. If the ID number is not available, use a radius of 610 m. If more information is available, a different radius may be specified in GENTEXT. Draw the circle of the specified radius centerd at the release location.

(b) Obtain the PROTECTIVE ACTION DISTANCE from the NAERG96 using the 4 digit UN/NA ID number and the size of the spill provided in field 5 of GOLF. If the size of the spill is not available, assume LRG. If the ID number is not available, use a distance of 11 km. **If the spill is greater than 1500 kg (XLG),** double the PROTECTIVE ACTION DISTANCE.

(c) **WIND SPEED** less than or equal to 10 KPH. The wind direction is then considered to be variable, so draw another circle of radius equal to the PROTECTIVE ACTION DISTANCE, also centered at the release location.

(d) **WIND SPEED** greater than 10 KPH. Draw a line in the downwind direction starting at the release location of length equal to the PROTECTIVE ACTION DISTANCE. Draw a line at the end of the downwind direction line perpendicular to the downwind direction. Extend the downwind direction line in the upwind direction a distance equal to twice the RELEASE AREA radius. Draw two lines from the upwind end of the downwind direction line to the perpendicular line at the other end which are tangent to the top and bottom of the RELEASE AREA circle. (See Figure C-I).

(e) **LIMITATIONS.** The initial hazard area is considered valid until additional information is available.

d. **Releases from a Bulk Storage Tank.** Chemical storage tanks can contain thousands of litres of TIC. Many of these chemicals exist as gases under atmospheric conditions and are stored as a liquid under high pressure and low temperatures. Some of the chemicals are extremely flammable as a vapour cloud. Damage to one of these tanks can result in the stored liquid being ejected very quickly as a large pool of very cold liquid. The pool will evaporate to form a vapour cloud which is considerably more dense than the surrounding air due to the lower temperature and differences in molecular weight. This cloud will initially be affected more by gravity than the wind. The cloud will begin to dilute by being mixed with surrounding air. Eventually, the cloud will no longer be denser than the air and will move with the air as any other vapour or aerosol cloud. At this point, however, the cloud concentration will most likely be low enough that it is no longer toxic. So, any prediction procedures must focus on the behaviour of the cloud before it has been diluted. This behaviour will be different than that predicted by assuming the hazard area resulting from the use of the NAERG2000. Several computer models have been developed to predict cloud behaviour from such releases. Some of the models also address the flammability of the cloud. These models are very complex and will not be discussed here. The simplified hazard areas are comprised of a circle with the release location at its center. The radius of the circle should be 2 km under daytime and 6 km under night time.

SECTION VI – REPORTING ROTA EVENTS

C-14. General. NATO and US forces will use the existing NBC Warning and Reporting System and associated message formats to report ROTA events. Initial reports of ROTA events will utilize the NBC 1 ROTA report if the release location is known; otherwise, a NBC 4 ROTA report will be generated. The NBC Center may use this information to develop a NBC 2 ROTA report, a simplified hazard prediction and a NBC 3 ROTA report. Additional readings from monitoring and directed surveys of the hazard area will use the NBC 4 ROTA report. The NBC Center will use this information to develop a plot of the actual contamination and the NBC 5 ROTA report and, finally, the system will use the NBC 6 ROTA report to pass additional information required for detailed prediction.

C-15. Identification. ROTA messages are identified as NBC 1 to 6 messages with the entry ROTA replacing the respective NUC, BIO and CHEM entries in NBCEVENT. Entries N, B, and C are replaced by RN, RB, and RC in field 4 of set ALFA.

C-16. NBC 1 ROTA. This report provides the observer’s initial report if the location of the source is known. The report will include sets ALFA, BRAVO, CHARLIE, FOXTROT, GOLF, INDIA, MIKER, TANGO, YANKEE, ZULU and GENTEXT with the information as currently described for NBC reports. Set CHARLIE provides the same information as set DELTA, except it indicates an observed ROTA event rather than an observed attack. Set GOLF will include the type of delivery, if applicable, and the ROTA type of container such as bunker (BUK), waste (WST), reactor (RCT), transport (TPT) or stockpile (STK), pressurised bottle (BTL), storage container (CON), 200 litres drum (DRM), storage tank (TNK), if known, in field 4. Field 5 of set GOLF will indicate the size of the release as small (SML), large (LRG) or extra large (XLG), if appropriate. Field 1 of set INDIA will indicate the observed release height. Field 2 of set INDIA will indicate the type of release as described above as RNP, TIM or the agent name or identification number. Field 3 of set INDIA will indicate the material persistency. Additional descriptive entries for a ROTA event can be entered into set MIKER. Set GENTEXT will provide, if available, further information concerning the level of radiation detected, the specific chemical compound or the type of biological agent.

C-17. NBC 2 ROTA. The NBC Center may assign a Strike Serial Number (ALFA) to the NBC 1 report and transmit the information as a NBC-2 report.

C-18. NBC 3 ROTA. This report provides a prediction of the ROTA hazard area in order to provide rapid force protection for NATO forces. The report will use the information as described in this manual for sets ALFA, CHARLIE, FOXTROT, GOLF, INDIA, PAPAR, PAPAX, YANKEE, ZULU, and GENTEXT. The hazard contour region is described in set PAPAX, with the defining RELEASE AREA and HAZARD AREA DISTANCE summarised in set PAPAR.

C-19. NBC 4 ROTA. This report is utilised either to pass subsequent off-target monitoring data or the results of a deliberate directed survey. The report will use the information as described in ATP-45 for sets ALFA, INDIA, QUEBEC, ROMEO, SIERRA, TANGO, WHISKEY, YANKEE, and ZULU. Set GENTEXT in this message will provide the initial background reading taken by the survey team for nuclear or radiological releases. Readings for set ROMEO will indicate readings above the initial reported background reading and measured values for chemical and biological. Decimals may be entered into set ROMEO if readings below 1 in the relevant unit of measurement are recorded e.g. 0.123456 cGy/hr.

C-20. NBC 5 ROTA. This report will outline the actual extent of the ROTA contamination from survey data. The report will use the information as described above for sets ALFA, CHARLIE, INDIA, YANKEE, ZULU, and GENTEXT. Set OSCAR indicates the time for which the contour is appropriate. Set XRAYA will describe the level of contamination for the contour and the contaminated area resulting from any ROTA event whether it is Nuclear, Biological or Chemical.

C-21. NBC 6 ROTA. This message will be used to provide, in set GENTEXT, specific information required to produce a more detailed ROTA hazard prediction.

Appendix D

NBC Intelligence Preparation of the Battlespace (IPB)

NBC IPB is accomplished at all levels from the individual soldier watching his counterpart on the other side to the joint staff considering theater level operations. This appendix will focus on the JIPB which is conducted to produce intelligence estimates and other intelligence products for a joint task force (JTF) in support of the Joint Force Commander's (JFC) decision making process. JIPB is a continuous process that enables the JFC and staff to visualize the full spectrum of threat capabilities and COAs across all dimensions of the battlespace. The NBC JIPB is a part of the overall JIPB process (not a separate process) that allows the JFC commander and staff to visualize threat NBC capabilities, and qualify and quantify NBC effects on the battlespace.

The NBC JIPB process supports the tactical, operational, and strategic levels of war as well as Military Operations Other Than War (MOOTW). The NBC JIPB results and products support mission analysis, COA development, COA selection, wargaming, and the development of OPLAN/POORDER. The NBC JIPB follows the four-step process outlined in Joint Publication 2-01.3, Joint Tactics, Techniques, and Procedures for Joint Intelligence Preparation of the Battlespace.

STEP 1. DEFINE THE BATTLEFIELD ENVIRONMENT.

With regard to NBC weapons, the total battlespace should encompass:

- All adversary countries, groups, or potential belligerents known to have or suspected of possessing an NBC capability.
- All current and potential locations of adversary and potential belligerent missiles, artillery, and aircraft capable of delivering NBC weapons, and
- All adversary known or suspected NBC agents and their storage and production facilities.

STEP 2. DESCRIBE THE BATTLEFIELD EFFECTS

- Identify and assess the vulnerability of key logistics facilities and infrastructure.
- Identify all known and suspected NBC agents.

- Identify critical weather information needed to determine the effects of weather on the use of NBC weapons. Analyze the seasonal or monthly normal variations in weather patterns that might affect the use of NBC weapons.

- Analyze the land and maritime surface dimensions to identify potential targets areas for NBC attack such as choke points, key terrain, and transportation nodes.

STEP 3. EVALUATE THE ADVERSARY

- Analyze adversary capabilities and will to employ specific types of NBC weapons. Determine the locations, volume, and condition of adversary NBC stockpiles.

- Identify the specific types and characteristics of all adversary NBC delivery systems, with special attention to minimum and maximum ranges.

- Evaluate adversary NBC doctrine to determine if NBC employment is terrain oriented, force oriented, or a combination of the two.

- Assess the level and proficiency of adversary NBC training and protective measures.

- Assess the practicality and timeliness of an adversary exploiting a new or different technology to develop an NBC capability (including delivery means).

STEP 4. DETERMINE ADVERSARY COURSES OF ACTION.

- Identify friendly assets that the adversary is most likely to target for NBC attack.

- Determine those locations where the adversary is most likely to deploy NBC delivery systems. These locations should be within range of potentially targeted friendly assets, yet still consistent with the aversary's deployment doctrine.

- Evaluate those characteristics of the adversary's NBC stockpile that may dictate or constrain NBC weapons use. These may include factors such as the quality and yield of nuclear weapons, the age and shelf life of stored chemical munitions, and the production and handling requirements for biological weapons.

CONCLUSION

The NBC JIPB supports several critical facets of joint command decision making. These include mission analysis, friendly COA development, wargaming, and COA selection. The NBC JIPB is a critical part of overall JIPB; therefore, the J2. J3, and NBC Staff must work together to ensure that all NBC JIPB products and analyses are fully integrated into the JTF operational planning.

Appendix E

TTPs for NBC Surveys

Reconnaissance locates contaminated areas, monitoring finds contamination on people and equipment, and surveys confirm and define contaminated areas. NBC surveys are conducted to provide detailed information to the commander on the extent and intensity of contamination. In chemical surveys, it is difficult to determine intensity of contamination; however, in radiological surveys, intensity can be measured using RADIAC instruments. Surveys are time and labor intensive and should only be conducted when absolutely necessary.

SECTION I – CHEMICAL SURVEYS

1-1. Chemical surveys are done to determine the extent of contamination in the area of interest or along specific routes through the area of interest. Once the reconnaissance team finds contamination, a survey is accomplished to define the size of the contaminated area. There are two types of surveys-complete or incomplete. A complete survey is when the entire extent of the contamination has been identified. An incomplete survey occurs when the entire extent of contamination has not been identified. This can occur when an NBC recon unit has to conduct a survey to find a bypass route during combat operations.

1-2. There are three survey techniques that can be employed once contamination is located. These techniques are near-side-far-side, box, and star. Each technique is usually performed while mounted to minimize exposure of servicemembers performing the survey to CB hazards.

- <u>Near Side Far Side:</u> This technique is used by the recon element once a vehicle enters the contaminated area. All vehicles in the recon element stop. Each vehicle crew determines if they are in the contaminated area. Vehicles in the contaminated area move back along their original path for 200 meters and again check for contamination (see Figure I-1). If they are out of the contaminated area, emplace the appropriate warning markers. If they are still in the contaminated area, they move back another 200 meters and test again. This process is repeated until they are clear of the contamination. Once the initial vehicle has found the near side boundary of contamination, it moves forward across the contaminated area, testing every 200 meters. Once the crew no longer detects any contamination, the

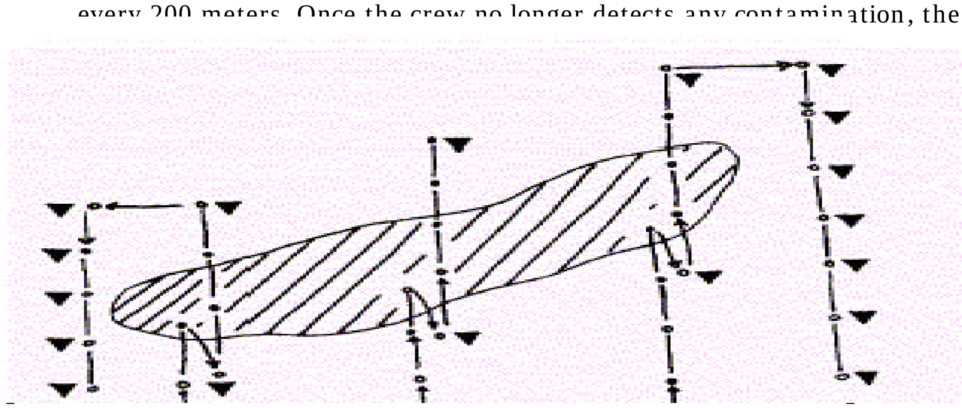


Figure E-2 Contaminated Area Extends Beyond Initial Right Limit of Survey

If no contamination is detected, a warning marker is placed. Each vehicle in the element executes this process to determine the near and far side boundaries of the contamination. It is possible that the right and left limits of the contamination are not identified, even though the right and left reconnaissance vehicles determined a near and far side (see Figure G-2). In this case, the recon element can shift vehicles to the right and left to attempt to find those boundaries or execute a box survey technique. The lateral spacing between vehicles is important to quickly locate all boundaries of the contaminated area. Once the boundaries are located, clear bypass routes can be easily located.

1-3. Box Technique: The box technique is used to determine the general dimensions of the contaminated area (length and width). This technique is best employed by a section (three vehicles). The process starts once a vehicle enters the contaminated area. All vehicles in the recon element stop. All vehicles check for contamination in their immediate areas. The first vehicle to report contamination becomes the base vehicle. If any other vehicles in the element are located in the contaminated area, they must back out of the contamination. All vehicles in the element should orient on the base vehicle, at least one vehicle should be to the right and left of the base vehicle.

The base vehicle has the mission to move forward and find the far side of the contamination. The crew continues to check for contamination every 200 meters. When the crew fails to get a positive reading, they proceed another 200 meters and establish the initial farside line. The vehicle to the right of the base vehicle places a warning marker to indicate the initial near side. This vehicle then moves forward 200 meters and checks for contamination.

The crew can find two things at this point, contamination or no contamination. If contamination is detected, the vehicle turns 90 degrees to the right and moves 200 meters and checks again. If no contamination is found, the vehicle moves forward 200 meters and checks again. This process of going straight or turning will continue in a box-like movement until the vehicle has crossed the initial far side line, this is the initial right limit of the contamination. The movement of the vehicle depends on the orientation of the contaminated area.

demonstrate the execution of a mission for various orientations. Once the vehicle has reached the initial far side line, the vehicle moves toward the base vehicle while checking for contamination. The vehicle to the left of the base vehicle executes the same movement as the right vehicle, except its first turn will be to the left. While this may sound complicated, it is not difficult to execute. The section leader must receive continuous reports from the other vehicles on their findings, positive or negative. From these reports the section leader plots the findings to get a general idea of the layout of the contamination.

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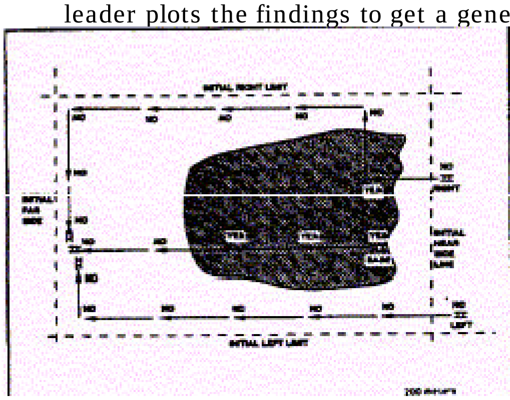
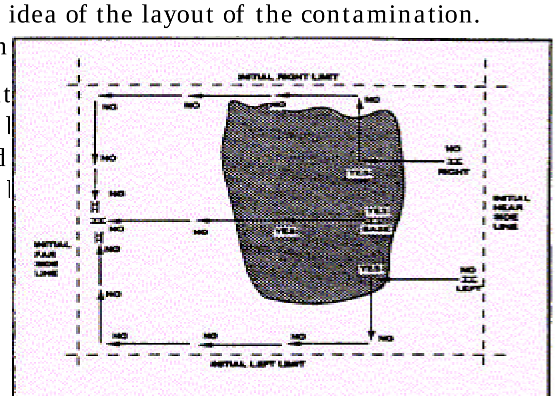
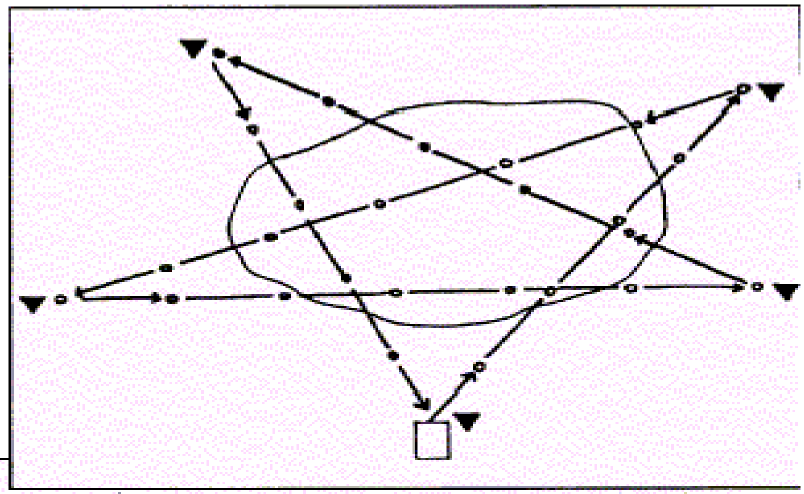




Figures E-3 and E-4 Box Survey Technique on Orientation A (E-3) and Orientation B (E-4)

Figure E-5 Box Survey Technique on Orientation C



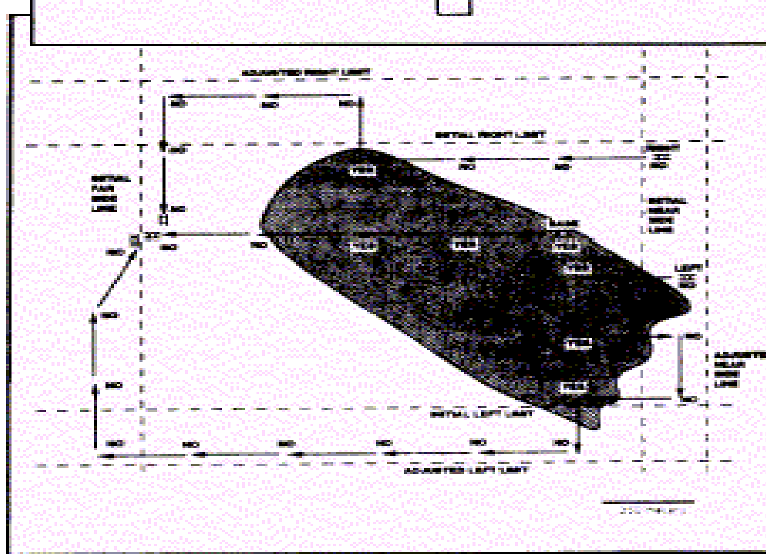


Figure G-6 Star survey Technique

1-4. <u>Star Technique:</u> This is a very quick technique to determine the rough limits of a contaminated area. The vehicle that encounters the contamination, moves back from the contaminated area 200 meters from the last positive reading. This point is the base of the star. The vehicle posts a warning marker. The vehicle then proceeds forward, detecting every 200 meters to find the far side. Once the vehicle has detected no agent, it proceeds for another 200 meters and tests again. If no agent is detected, another warning marker is posted. This ends the first leg of the star. The vehicle turns about 135 degrees and travels in that direction detecting every 200 meters. If no contamination is detected on this leg, the vehicle should not travel any longer than the length of the initial leg. This process is repeated

until the vehicle arrives at or near the base of the star (see Figure E-6). This technique can be used by a squad or section to obtain more detecting points, increasing the accuracy of the survey (see Figure E-7).

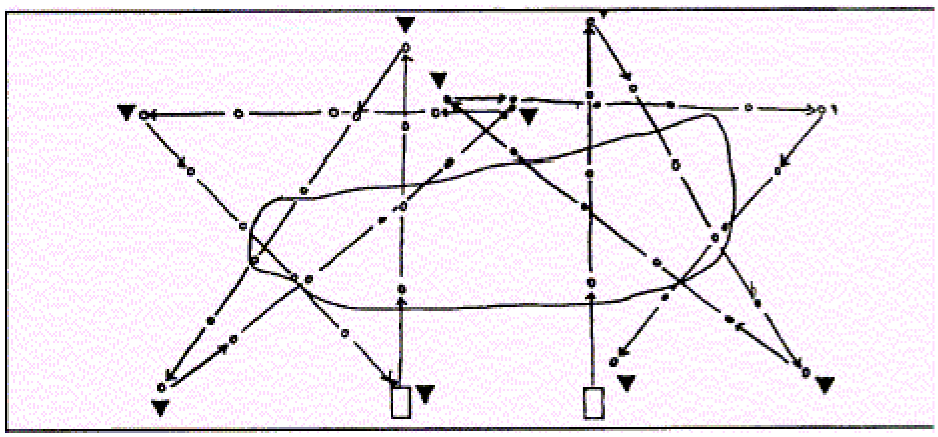


Figure E-7 Pattern of NBC Recon Squad Performing Star Technique With Two NBC Recon Vehicles

1-5. The M93A1 NBC Recon Vehicle has an automated system with the detection systems linked with the global positioning system (GPS) and the on board meteorological systems. This automated system rapidly transmits readings and other data to the NBC Center through the Maneuver Control System Net. For those conducting surveys without automation, results should be recorded on a DA form 1971-2-R or similar matrix. The important information is the type of agent, the location where it was detected, and the type of detector used.

SECTION II – RADIOLOGICAL SURVEYS

1-6. Nuclear surveys are conducted to find the extent and intensity of contamination. Radiological monitoring and reconnaissance provides general information about contamination for immediate operations. Surveys provide detailed information on which future operations are based. Surveys require time and coordination. Men and equipment must be diverted from primary missions. Because of these circumstances, surveys are conducted only when the intensity of contamination must be known. Future dose rates can be predicted from the data provided by monitoring or survey. Recon cannot provide sufficient data for this. Monitoring provides data only in areas occupied by troops.

1-7. If no operations are planned in the area, a survey is not required. However, if there is a remote chance that this is not the case, a survey should be conducted at the earliest opportunity. Current techniques are designed for reasonable safe survey of high dose rate areas. Once the contamination has decayed, the survey will be difficult. Often, a survey will be delayed until the area is under friendly control. Survey in the Covering Force Area (CFA) or forward of the Forward Line of Troops (FLOT) is not done unless knowledge is imperative and loss of survey team is acceptable. This will be an extremely rare case.

Calculations based upon survey data are a series of approximations. These are sufficient for field use; however, best accuracy is obtained by resurveying the area every few days. Theoretically, once a radiological hazard has been identified, the contamination existing at any future time can be calculated. However, weathering and inaccuracies in initial survey make this approach unrealistic. Frequent resurvey of contaminated areas is essential. The frequency and detail of resurvey will be determined by the reliability of the initial survey. Resurvey will be planned and conducted in the same way as the initial survey.

Surveys are not conducted by units unless directed. The NBCC will initiate surveys or request that a subordinate unit be directed to conduct a survey.

A survey is performed by a group comprised of a defense team and one or more survey teams. The defense team, consisting of one or more men, plans and directs the survey. It screens and transmits the data to the authority that ordered the survey. The survey team, organized within the company/troop/battery NBC team, consists of a monitor and necessary support and security personnel. Only the minimum number of personnel are exposed to radiation. The defense team briefs the survey teams and controls their movements.

There are two types of surveys, aerial and ground. The type used depends on many factors. Aerial surveys are conducted for large areas and have advantages over ground surveys. They are faster and more flexible. They expose personnel to lower doses, and require fewer personnel and equipment to perform. However, aircraft may not always be available. Ground surveys can be done under unit control using unit equipment. They can be done in any type of weather, and they can be done when aircraft cannot fly. They are more accurate than aerial surveys. These points are considered by the NBCC when deciding the type of survey to use.

SURVEY PLANNING AT THE NBC CENTER

1-8. Radiological contamination on the nuclear battlefield may cover large areas. It may occur in many locations with overlap of contaminated areas, and may be in varying stages of decay. Initial detection of new contamination will probably be in the form of NBC 4 nuclear Contact reports from recon elements. These reports will alert the command to the presence of a previously undetected hazard. This will cause a new series of orders and requests to be initiated for radiological information. These orders and requests will be superimposed upon existing survey plans already functioning for older contaminated areas. Thus, the supervision and coordination of the radiological intelligence effort will be a continuing process. The NBCC initiates all radiological surveys. This ensures that the right amount of data is obtained at the right time. It also ensures that surveys are not initiated when data is not required. This reduces the burden of subordinate units. Subordinate units execute only their assigned portions of the plan(s).

Reliability of Survey Data. There are many factors which will impact on the accuracy and reliability of survey data. The type and source of contamination will determine the survey requirements and sequence of calculations to be performed. The types and sources of radiological contamination are the following:

- Induced contamination. Contamination resulting from a nuclear burst where the contamination can be related to a specific nuclear burst where fallout did not occur, or contamination localized around an obvious ground zero area.
- Fallout (known weapon). Contamination arriving or identifiable as fallout which can be related to a particular nuclear burst.
- Fallout (unknown weapon). Contamination arriving identifiable as fallout which cannot be related to a particular nuclear burst.
- Contamination (unknown source). Contamination identifiable as induced or fallout which cannot be related to a known source.
- Combinations and multiples of the above.

Factors Affecting the Survey Plan

1-9. The following paragraphs list some of the factors affecting survey planning with guidance concerning their major effects. In preparing the survey plan, each factor must be estimated and balanced against the need for information:

- **Knowledge of the Contamination.** Knowledge about the contaminated area which is available or expected to be available (such as recon data and monitoring reports) will help determine the size of the area to be surveyed and the amount of detail required.
- **Operational Situation.** In rapidly changing situations, centralized control is necessary. Under such conditions, aerial survey is required for critical counterattack routes. A checkpoint overlay for aerial survey planning will be prepared as areas are assigned or as areas of interest change. Main supply routes and so forth may be surveyed using the ground technique later. The operational situation will dictate the availability of personnel and equipment.
- **Urgency.** Aerial surveys are normally the most rapid means of obtaining information.
- **Weather.** Aerial surveys may be precluded by poor visibility. Surveys should be delayed during precipitation and high winds. These conditions tend to change a contamination pattern. Ground surveys can be

accomplished in any weather, except as noted. Aerial surveys may be precluded by bad weather.

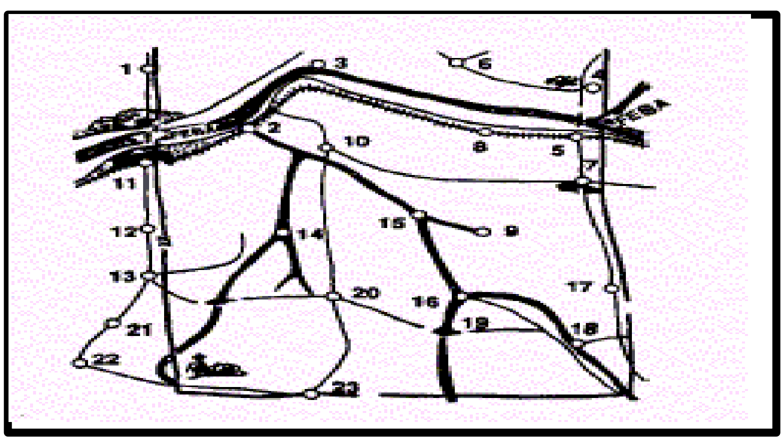
- **Terrain.** Lack of road nets or the inability of the soil to support ground movement may eliminate a ground survey. An aerial survey is of limited use in mountainous terrain. In areas such as arctic, desert, or jungle, where reference points are rare, marking reference points with cans of paint or bags of talc or flour may be required. The type of survey must be carefully selected. Often radio fixes and precise time, distance, speed, and direction calculations must be made.
- **Status of Training.** Inadequate training or losses of trained personnel may limit survey capability. The status of training must be considered in selection of the type of survey. Status of training of defense teams at subordinate headquarters will also affect this. A record of equipment status and training status of available monitors, survey teams, and subordinate defense teams must be maintained for survey planning. Aerial survey requires the best or most well-trained monitors.
- **Time-distance.** Time-distance factors must be estimated and considered when selecting the most appropriate type of survey to obtain data and allow evaluation within the commander's time limits. Survey operations are not initiated until fallout has ceased. Dependence upon monitoring reports is the primary method of obtaining a rough estimate of contamination information during arrival of fallout.
- **Dose.** Dose status of survey personnel and the operation exposure guidance set by the commander must be evaluated when planning the type of survey.
- **Communications.** Availability of communications will affect all phases of the survey plan. Aerial survey will normally impose the least communications load or risk.
- **Maps.** The NBCC must consider maps and the areas they cover. These maps must be available to units that will participate in the survey.
- **Area Coverage.** All helicopters have approximately the same survey area coverage capability of between 130 and 450 square kilometers per hour per aircraft, depending upon the detail required. Any powered vehicle is satisfactory for conducting ground surveys. All vehicles have approximately the same area coverage capability of between 15 and 40 square kilometers per hour per vehicle, depending upon the degree of detail required, the road network, and the trafficability of the contaminated area. However, because of the superior shielding and cross-country characteristics of the tracked armored vehicle, this type of vehicle is preferred. Regardless of the type of vehicle used, additional shielding (sand bags or metal plates) is always added to the vehicle. To determine how much additional shielding to add to the vehicle, refer to Appendix I and the vehicle data plate for load density. This will reduce the total dose of survey personnel. Selection of the type of vehicle used is based upon the relative shielding correlation factors of one vehicle compared to another.
- **Contamination.** A listing or an overlay showing points, routes, or areas where contamination could seriously affect accomplishment of the mission

will be maintained for survey planning. These areas, routes, and points are prioritized to help with survey planning.

- **Damage Assessment.** Often a helicopter will be deployed to conduct area damage assessment after an attack. When this occurs, survey and damage assessment can be combined.
- **Multiple Bursts/Sources of Contamination.** When multiple bursts occur, fallout can overlap other fallout areas or induced areas can interlock. Also, several sources can overlap one another such as a neutron-induced area overlapped by fallout.

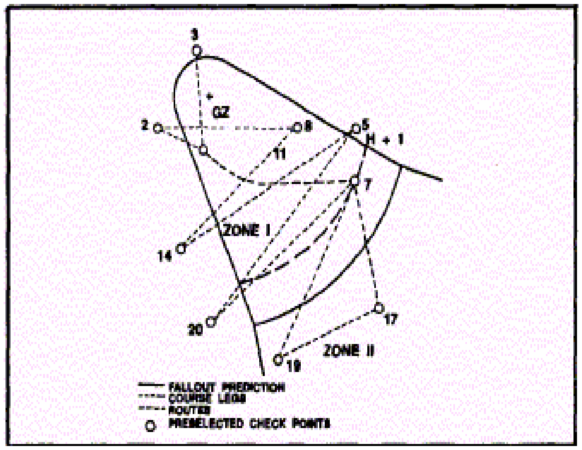
Planning Ground and Air Surveys

The basis for planning an aerial survey is the checkpoint overlay. Checkpoints that are easily identified from the air and on a map (small bodies of water, streams, or road junctions) are selected for the entire area of responsibility by the NBCC in coordination with the aviation section. These checkpoints are maintained as an overlay by these two staffs. Then, when a survey requirement is established, the defense team selects a series of course legs, routes, and points where data will provide sufficient ground dose-rate information to evaluate the contaminated area. Figure G-8 illustrates a divisional area with preselected checkpoints. This overlay is used with the fallout prediction or neutron-induced prediction. Figure G-9 shows an overlay plan for an aerial survey. Figure G-10 shows an overlay plan for the ground survey portion of the plan. When survey of neutron-induced areas is required, a single course leg is selected which will pass directly through ground zero. The survey will begin at the edge of the contaminated area. Since the contaminated area is taken to be circular, survey ceases at ground zero.

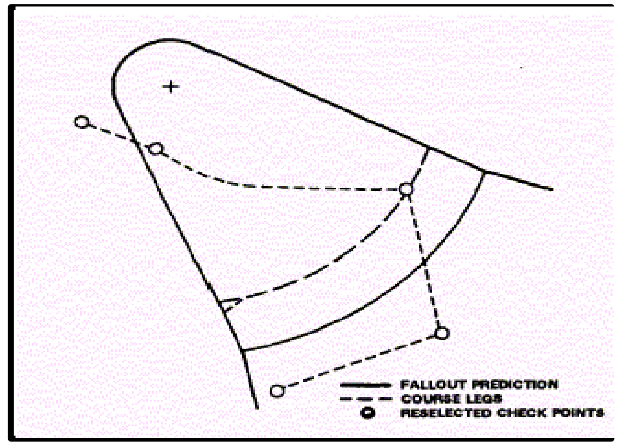


E-8 Division Area Showing Preselected Checkpoints

Dose rates equal to those found on the course leg are assumed to be present on the other side of ground zero in reverse order. When conducting a survey of an induced area, use the AN/VDR2 Radiacmeter. Only this survey instrument is capable of detecting the entire radiation hazard. Thus, the final plot will be concentric circles. When a survey of neutron-induced areas is required,only aerial survey is used. Ground survey will result in unacceptable total doses for survey personnel.



E-9 Planned Aerial Survey Overlay



E-10 Planned Ground Survey Overlay

Survey Team Briefing

1-10. Adequate control of the radiological survey, once initiated, will depend to a large extent upon proper briefing of the survey teams. Survey team briefings may vary from group to individual briefings. This depends upon space, time, and operational conditions; briefings may be given in oral, written, overlay, or other form. In any case, a briefing should always be conducted. The written or oral briefing is essentially an order. It should generally follow the form of the five-paragraph operation order. The following is a radiological survey party briefing order reference list (List any maps, charts, or other documents necessary to understand the order.):

Radiological Survey Party Briefing Reference List

1. Situation.

a. Operational Situation. Briefly describe the operational situation as it concerns conduct of the survey, to include enemy forces, friendly forces, and planned actions.

b. Contamination Situation. Present any factual information available about the contaminated area, to include limits, dose rates, sources of contamination, terrain, and weather.

2. Mission.

Clear, concise statement of task to be accomplished (who, what, when, where, and why).

3. Execution.

a. Concept of Operation.

b. Specific Assignment of Each Team. In subsequent separate lettered subparagraphs (such as a, b, c, d, and e) give a specific task of each survey party. Include the coordination required.

c. Coordinating Instructions. The last subparagraph of paragraph 3 of the order contains instructions applicable to two or more of the survey teams, such as—

(1) Time of departure and return.

(2) Routes and alternate routes to and from the contaminated area.

(3) Coordination required.

(4) Dose danger limitations. If the AN/VDR-2 is to be used to check for turnback dose (or dose rate), this value shall be entered as the alarm setpoint and checked prior to departure (turnback dose and operation exposure guidance).

(5) Actions to be taken upon reaching limitations in (4) above.

(6) Whether and when marking of contaminated areas is required.

(7) Debriefing-where, when, by whom.

(8) Decontamination - if required, when, where, and by whom.

4. Administration and Logistics.

Contains information such as required equipment and forms.

5. Command and Signal.

a. Command. Location of defense team.

b. Signal.

(1) Data reporting procedure.

(2) Special instructions concerning SOI.

(3) Call signs, code to be used, and reporting times.

(4) Communications means (primary and alternate).

Types of Aerial Surveys

1-11. Aerial surveys are conducted rapidly and at a distance from the radiation source. Therefore, aerial survey teams are exposed to considerably less radiation than ground survey teams if an equivalent ground survey were conducted over the same area. Aerial surveys can be employed over areas that have dose rates unacceptably dangerous to ground survey teams. Because of speed and flexibility, aerial surveys can be employed over large areas, over unoccupied areas of operational concern, over enemy occupied areas, and over areas of difficult accessibility to ground troops. Aerial survey is preferable when conducting surveys of large areas. The advantages of aerial survey over ground survey are speed and flexibility of employment; lower radiation doses to survey team members, and minimum requirements for equipment, personnel, and communications. However, the dose-rate readings are not as accurate as those obtained by ground survey. Another disadvantage is that dose rates for specific points on the ground may not be provided by aerial survey.

1-12. The techniques used to conduct detailed aerial surveys include the route technique, the course leg technique, and the point technique.

- In using the route technique, the pilot flies between two checkpoints, following the route of some predominant terrain feature such as a road that connects the two checkpoints.
- In using the course leg technique, the pilot flies a straight line course (course leg) between two checkpoints. The procedure followed in obtaining dose-rate information between checkpoints is the same, using either the route technique or the course leg technique. When the dose-rate information obtained from either technique is processed, the result is a series of ground dose rates spaced at equidistant intervals along the path over which the aircraft flew.
- The point technique is used to determine the ground dose rate at points of operational concern and is normally employed to obtain more precise dose-rate information at those points than can be obtained by use of other aerial survey techniques. Processed data from dose-rate information obtained using the point technique are ground dose rates existing at each of the selected points.

Conducting Aerial Surveys

1-13. The course leg technique requires that the aerial survey party fly a straight line course (course leg) between two checkpoints. The pilot maintains as near as possible a constant height above the ground, a constant ground speed, and a straight flight direction between the starting and ending checkpoints of each course leg. The pilot locates the starting checkpoint of a course leg to be flown and either locates the end checkpoint or determines the azimuth of the course leg. The pilot flies the aircraft on the proper course to pass over the initial checkpoint on a straight path to the end checkpoint. When on course, the pilot alerts the monitor and gives him the height above ground. Shortly before reaching the initial checkpoint, the monitor records the time and height above ground. The monitor rechecks/rezeroes the survey instrument before each course leg, to assure proper operation. The pilot commands “Mark” when the aircraft is directly over the starting checkpoint, at which time the monitor reads the survey meter, records the dose rate, and begins timing preselected time intervals. The monitor reads the survey meter and records the dose rate at each preselected time interval (for example, every 10 seconds). The pilot again alerts the monitor when the aircraft approaches the end checkpoint. When the aircraft is directly over the end checkpoint, the pilot commands “Mark”. At this time, the monitor reads and records the final dose rate.

The procedures for a route survey are identical to those for a course leg survey. However, this may or may not require a straight flight direction.

Procedures for a point survey require the aircraft to land near the point of interest. The monitor dismounts, proceeds to the selected point, and takes the reading by using normal ground monitoring procedures. When high dose rates do not permit this procedure, aerial dose rates are taken and air-ground correlation factor (AGCF) data are applied by the NBCC.

Air-Ground Correlation Factors

1-14. An AGCF is required for calculation of ground dose rates from aerial dose rates taken in an aircraft during a survey. The AGCF is the ratio of a ground dose-rate reading to a reading taken at approximately the same time in an aircraft at survey height over the same point on the ground. There are two techniques for obtaining the AGCF.

The preferred technique is by direct determination of ground and aerial dose rates during the survey and subsequent calculation of the AGCF. The AGCF may be calculated as shown below, using the aerial dose rate taken at survey height and the ground dose rate:

Ground dose rate = 20 cGyph.

Aerial dose rate (60-meter survey height) = 5 cGyph

$$\text{Air-ground correlation factor} = \frac{\text{Ground dose rate}}{\text{Aerial dose rate}}$$
$$= \frac{20\ \text{cGyph}}{5\ \text{cGyph}}$$
$$\text{AGCF} = 4.$$

By multiplying the reading taken in the aircraft at a survey height of 60 meters by the AGCF, the 1-meter above ground level reading can be estimated. The procedure for determining the ground dose-rate reading involves landing near the selected point. The monitor proceeds to that point and takes the ground dose-rate reading, using normal monitoring procedures. AGCF data are obtained if possible for each two to four course legs or routes flown. The sites for obtaining AGCF data should be selected to approximate average foliage and ground surface conditions in the contaminated area. Accuracy of this AGCF data as to position, height above ground, and dose rate is of primary importance. New data must be obtained when survey height changes by 15 meters or more, when ground foliage or average ground surface conditions change significantly, if the aircraft or the survey meter is changed, or if weather conditions change drastically during monitoring.

When the tactical situation, terrain conditions, high radiation dose rates, or other factors do not permit the use of the preferred technique, the AGCF shown in Table I-1 are used. To estimate a ground dose rate, multiply the aerial dose rate obtained by the correlation factor from Table I-1 for the type of aircraft and the height above ground at which the reading was taken. In the following example, while flying at a 150-meter survey height in a UH-1, a reading of 10 cGyph was obtained; the AGCF for a UH-1 at a height of 150 meters is 8.2:

$$\text{Ground dose rate} = \text{Aerial dose rate} \times \text{AGCF}$$
$$= 10\ \text{cGyph} \times 8.2$$
$$= 82\ \text{cGyph}.$$

APPENDIX F
GLOSSARY

Aerosol. A liquid or solid composed of finely divided particles suspended in a gaseous medium.

Antiterrorism. Defense measures used to reduce the vulnerability of individuals and property to terrorist acts, to include limited response and containment.

Area of Operations. Portion of a conflict area necessary for military operations. AOs are geographical areas assigned to commanders for which they have responsibility and in which they have the authority to conduct military operations.

Army/Air National Guard. National Guard Forces, not in active Federal Service, remains under the control of the State Governor, and are included in local resources available to civil authorities. When activated for Federal Service, the National Guard forces come under the control of the Active Army.

Avoidance. Measures taken by individuals or units to avoid or minimize and/or reduce the effects of NBC, WMD, and TIM hazards. Avoidance involves the passive and active measures employed to avoid subsequent contamination.

Biological Agents. Microorganisms or toxins from organisms that have infectious or noninfectious properties that produce lethal or serious health effects in plants or animals.

Biological Agents and Agents of Biological Origin are generally divided into either replicating (pathogenic or infectious) agents such as bacteria, viruses or fungus or non-replicating (non-infectious or intoxicating) agents produced from replicating agents, other living organisms, and plants and are called "toxins". Toxins may also be man-made. Numerous naturally occurring agents as well as genetically engineered organisms, have the ability to kill or incapacitate large numbers of people. Biological agent exposure danger is further complicated by:

- Agent effects are delayed due to incubation period or agent intoxication

- Comprehensive quick field detection and identification methods do not currently exist

- Accurate initial diagnosis be difficult

- Medical treatment for some agents may be diminished when symptoms have developed

- Personal protection consists of immunization or the application of post-incident medical treatment, such as antibiotics. A respirator provides personnel protection from biological agents. Biological agent classifications and effects are:

Viruses primarily cause diseases in man. Transmission of viruses would most likely be accomplished by aerosol dissemination, or the use of a vector (a living organism capable of infecting a victim). Symptoms such as fever, headache, nausea, and vomiting follow an incubation period of hours or days. Untreated/treated agent fatalities are agent, concentration, and route of infection dependent.

Bacterial agents can be produced or purchased from medical research firms. Dissemination may be by aerosol (respiratory) or natural dispersal such as food contamination (gastro-intestinal tract).

Fungal infections usually are induced through the respiratory system by breathing infected spores spread through the civilian or agricultural population. Fungal infections do not lend themselves for use as a weaponized biological agent.

Toxins are poisonous substances are derived from living organisms and can cause incapacitation or death quickly. Biotechnology advances pose the possibility for new generations of chemical and biological weapons.

Biological Defense. Methods, plans, and procedures involved in establishing and executing defensive measures against attacks using biological agents.

Biological Weapons. Any item of material that projects, disperses, or disseminates a biological agent, including anthropod vectors.

Centigray (cGy). Unit of measurement for radioactivity replacing the RAD.

Chemical Accident-Incident. Chemical event resulting from a deliberate-or non-deliberate event where the safety and/or security of is a primary concern.

Chemical Agents. Solids, liquids, or gases that have properties that produce lethal or serious health effects in plants or animals.

Chemical Agent Casualty. A person that has been affected sufficiently by a military toxic chemical agent or toxic industrial chemical to prevent or seriously degrade the ability to continue the mission.

Chemical Agent Symbol. The military code designation for a chemical agent (See FM 3-9 et al).

Chemical Contamination. The presence of a chemical agent on a person, object, or area.

Chemical Material. Chemicals present hazards if inhaled, ingested, absorbed, or any combination thereof. Technical Escort personnel accompanying shipments should be consulted for agent Materiel Systems Data Sheets, as should the shipper, for specific hazards associated with military chemical agents. A listing of commercial publications that will provide guidance in planning appropriate CAI response is in Enclosure 1 to Toxic Industrial Material (TIM), Chapter 2. All chemicals can be further defined as compounds that, through their chemical properties, may produce lethal or damaging effects in man, animal, plants, or materials. They exist as solids, liquids, or gas and are classified by effect they have on the human body (i.e., nerve, blood, choking, or blister agents). Chemical agents are further divided into three broad classifications, sometimes referred to as lethal agents, incapacitating agents, and harassing agents. The actions of these agents on the body are:

- Lethal agents are designed to kill or severely injure.

- Incapacitating agents are designed to disable the victim for at least several hours. These substances include those previously mentioned: nerve, blood, choking and blister agents.

- Harassing agents include police riot control agents, generally considered non-lethal, that have been designed to force people to retreat. However, depending on the circumstances and conditions, even harassing agents can result in serious medical complications.

Nerve agents, such as Tabun, Sarin, or VX, may be absorbed through the skin or respiratory tract. Exposure causes a disruption of nerve impulse transmissions and in sufficient quantities may cause rapid onset of symptoms followed by death. Full personal protective equipment (PPE) required by 29 CFR 1910 or clothing and equipment approved and provided by the separate services is required to ensure individual safety. Nerve agents are stored as liquids and usually disseminated as aerosols by an explosive charge or circulated by aerosol dispensers.

Blood agents, such as hydrogen cyanide and cyanogen chloride, are generally colorless liquids widely used in commercial chemical manufacturing. They interfere with cell respiration by attacking the body through the respiratory system and, when inhaled in sufficient quantities, are fast acting. Cardiac arrest can occur almost instantly. Although blood agents are fast acting, they dissipate quickly and are not as effective for long periods. A protective mask provides short-term protection. However, filter saturation of charcoal filters occurs quickly. Blood agents are disseminated by aerosol sprayer or vaporized by explosive charge.

Choking agents cause damage to the tissues of the respiratory system and the eyes. In sufficient amounts, secondary infections can take place and in higher concentrations death occurs. A protective mask is sufficient to provide protection, in an oxygen sufficient atmosphere.

Blister agents are tissue irritants. The most common blister agent is mustard. As a liquid, mustard has the consistency of motor oil. Significant exposure results in death between the second day and the fourth week. Lesser exposure to blister agents causes severe skin bums and may result in secondary infections. Generally, blister agents are not lethal unless exposure is significant. Effects of inhalation or contact with the eyes is immediate searing pain. Full protective clothing and a respirator are required to ensure safety. Lethality of chemical agents is dependent on the concentration and method of induction into the body.

C². Command and Control.

Cold Zone. Area where the command post and support functions that are necessary to control the incident are located. This is also referred to as the clean zone, green zone, or support zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

Collective Protection. Use of shelters to provide a contamination-free environment for personnel and equipment.

Collective-Protection Shelter. A shelter, with filtered air, that provides a contamination-free environment for personnel/equipment and allows relief from increased protective postures.

Combating Terrorism. Actions, including antiterrorism (defensive measures taken to reduce vulnerability to terrorism acts) and counterterrorism (offensive measures taken to prevent, deter, and respond to terrorism) taken to oppose terrorism throughout the entire threat spectrum.

Commander's critical information requirements. The information the commander needs to visualize the outcome of current operations. Includes information on both friendly and enemy forces.

Consequence Management. Refers to measures taken to protect public health and safety, restore essential government services, and provide emergency relief to governments, businesses, and individuals affected by the consequences of terrorism (Federal Emergency Management Agency (FEMA) definition).

Contaminate. Accidental or deliberate introduction of a toxic chemical agent, biological agent, or radiological material into an otherwise clean environment.

Contamination. Deposit and/or absorption of radioactive, biological, or chemical agents on and by structures, areas, personnel, or objects; food and/or water made unfit for human consumption by the presence of environmental chemicals, chemical agents, radioactive elements, bacteria, or organisms.

Contamination Control. Procedures instituted to limit the spread of contamination from the site of original deposition; includes control of decontamination solutions used during the decontamination process.

Contamination avoidance. Individual and/or unit measures taken to avoid or minimize NBC attacks and reduce NBC hazard effects.

CONUS. Includes all located in the continental United States (excludes Alaska and Hawii - see OCONUS).

Counterterrorism. Offensive measures taken to prevent, deter, and to respond to terrorism.

Course of action. A possible plan open to an individual or commander that would accomplish or is related to mission accomplishment. A COA is initially stated in broad terms with the details determined during staff wargaming.

Crisis Management: Refers to measures to identify, acquire, and plan the use of resources needed to anticipate, prevent, and/or resolve a threat or act of terrorism. The Federal Government exercises primary authority to prevent preempt, and terminate threats or acts of terrorism and to apprehend and prosecute the perpetrators; state and local governments provide assistance as required. Crisis management is primarily a law enforcement function (Federal Response Plan, April 1999).

Consequence Management. Those planning actions and preparations taken to identify, organize, equip, and train emergency response forces and to develop and execute plans implemented in response to an accident; and, the actions following an accident to mitigate and recover from the effects of an accident. (DODD 3150.8).

Consequence Management. Interagency services and activities essential to mitigating damage, loss, hardship, or suffering resulting from disasters or catastrophes, either manmade or natural (JP1-02, Revised FC).

Consequence Management. Comprises those essential services and activities required to manage and mitigate problems resulting from disasters and catastrophes, resulting from natural manmade, or terrorist incidents (DODD 3025.15; JP 3.07.7 (FC).).

Decontaminate. To break down, neutralize, or remove a chemical, biological or radioactive material.

Decontamination. Process of making personnel, objects, or areas safe by absorbing, destroying, neutralizing, making harmless, or removing the NBC, WMD, or TIM hazard.

Detection. Locating hazards by use of detectors or monitoring/survey teams.

Entry Control Point. Designated point of entry and/or exit into the hot zone, warm zone, and cold zone. The entry control point is used to maintain control of the numbers of personnel and vehicles entering and departing from the different zones to insure that the appropriate level of individual protection is worn and that appropriate decontamination has occurred/will occur upon exit from the contaminated area.

Emergency Medical Services. A system that provides personnel, facilities, and equipment for the delivery of medical care services under emergency conditions.

Emergency Operations Center (EOC). The protected site from which civil government officials (municipal, county, state, and federal) exercise direction and control in an emergency.

Emergency Operations Plan (EOP). A state or local document that describes actions to be taken in the event of natural disasters, technological accidents, or nuclear attack. The EOP identifies authorities, relationships, and the actions to be taken by whom, what, when, and where, based on predetermined assumptions, objectives, and existing capabilities.

Entry Control Point. Point of access and egress from a disaster, accident-incident site; designated by the On-Scene Commander (OSC).

Evacuation. Organized, phased, and supervised dispersal of civilians from dangerous or potentially dangerous areas, and their reception and care in safe areas.

Evacuation Area. The total area encompassed by the reception area necessary to receive evacuees from a risk area or group of closely related risk areas.

Explosives. Some chemical munitions may contain explosives when shipped. In the event of an accident, these explosives constitute an additional hazard. Fires involving potential explosive hazards should be fought in accordance with the provisions of applicable service publications (i.e., TM 5-315, *Fire Fighting and Rescue Procedures in Theater of Operations* and TM 9-1300-206, *Care, Handling, Preservation, and Destruction*).

Federal Bureau of investigation (FBI). The federal department responsible for planning, directing and coordinating federal crisis management assistance to Federal, State, and local authorities during a Chemical/Biological (CB) terrorist incident.

Federal Emergency Management Agency (FEMA). The federal department responsible for planning, directing, and coordinating federal consequence management assistance to Federal, State, and local authorities during a CB terrorist incident.

Gamma radiation. Electromagnetic radiations of high photon energy originating in atomic nuclei and accompanying many nuclear reactions such as fission. Physically, gamma rays are identical with X-rays of high energy.

Hazardous Substances. Elements, compounds, or mixtures (other than oil) which, when discharged in any quantity onto land or into or upon navigable or coastal waters, presents an imminent and substantial danger to the public health or welfare including fish, shellfish, wildlife, shorelines, and beaches. Hazardous substances include strong acids, strong bases, potentially toxic pesticides, or other bulk stored chemicals used in manufacturing processes or repair operations.

Herbicide. A chemical compound that will kill or damage plants.

Host-Nation Support. Civil and/or military assistance rendered by a nation to foreign forces within its territory during peacetime, crisis or emergencies, or war based on agreements mutually concluded between nations.

Hot Zone. Area immediately surrounding a dangerous goods incident which extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone. The zone is also referred to as exclusion zone, red zone or restricted zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29CFR 1910.120, NFPA 472).

Identification. Positively identifying field concentrations of NBC, WMD, TIM hazards through the use of detection equipment and/or devices.

Immediate Decontamination. (Also Emergency Decontamination) Decontamination carried out as soon as practicable after arrival on-site by operational level responders dressed in the appropriate level of personal protective equipment.

Immediate Response. Any form of immediate action taken by a DOD component or military commander, under authority of DOD Directive 3025.1 and any supplemental guidance prescribed by the head of a DOD component to assist civil authorities or the public to save lives, prevent human suffering, or mitigate great property damage under imminently serious conditions occurring where there has not been any declaration of major disaster or emergency, by the president or attack.

Immediate Response Zone. The area immediately around the accident-incident site that extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone. This zone is also referred to as exclusion zone, restricted zone, or hot zone in other documents.

Imminently Serious Conditions. Emergency conditions in which in the judgement of the military commander or responsible DOD official, immediate and possibly serious danger threatens the public and prompt action is needed to save lives, prevent human suffering, or mitigate great property damage. Under these conditions, timely prior approval from higher headquarters may not be possible before action is necessary for effective response (DODD 3025.1).

Individual Protection. Protection provided to individual through the use of personal protective equipment.

Individual Protection Equipment Ensembles. The level of protection required for the handling or inspecting chemical agents. The level of protection will vary depending on the chemical agents and the work area; usually a minimum of carrying a protective mask for emergency use.

Initial Response Force. First response teams on site of an accident-incident; includes fire, security, medical, EOD; conducts lifesaving, rescue, suppression, and containment activities.

Installation. Grouping of facilities, located in the same vicinity, that support particular functions.

Installation Commander. Individual responsible for all operations conducted by an installation.

Industrial Chemicals. Chemicals developed or manufactured for use in industrial operations or research by industry, government, or academia. These chemicals primary use is in industry and not for the specific purpose of producing casualties or rendering equipment, facilities, or areas dangerous for use by man. Some industrial agents such as hydrogen cyanide, cyanogen chloride, phosgene, and chloropicrin can be used as military chemicals agents.

Interactive Detection Networks. A system of NBC surveillance, detection, identification, monitoring, and reconnaissance elements that feed into the NBC Battle Management System.

Joint. Activities, operations, or organizations in which elements of more than one Service of the same nation participate.

Joint Force Commander. General term applied to a combatant commander, sub-unified commander, or joint task force commander authorized to exercise combatant command (command authority) or operational control over a joint force.

Lead Federal Agency (LFA). Agency named in various Federal emergency operations plan (National Contingency Plan, Federal Radiological Emergency Response Plan, Federal Response Plan, etc.) with primary responsibility to coordinate the Federal response. The type of emergency determines the LFA. In general, an LFA establishes operational structures and procedures to assemble and work with agencies providing direct support to the LFA in order to obtain an initial assessment of the situation, develop an action plan, and monitor and update operational priorities. The LFA ensures that each agency exercises its concurrent and distinct authorities and supports the LFA in carrying out relevant policy. Specific responsibilities of an LFA vary according to the agency's unique statutory authorities. If the incident also involves concurrent implementation of the FRP, the LFA and FEMA coordinate to the maximum extent practical to ensure effective, unified Federal actions, consistent with their distinct authorities and responsibilities. Direct FEMA support to an LFA is limited to FEMA's own authorities, resources, and expertise as an individual agency. In a response to an emergency involving a radiological hazard, the LFA under the FRERP is responsible for Federal oversight of activities on site and Federal assistance to conduct radiological monitoring and assessment and develop protective action recommendations. When a radiological emergency warrants action under the Stafford Act, FEMA uses the FRP to coordinate the nonradiological response to consequences off site in support of the affected State and local governments. If the FRERP and FRP are implemented concurrently, the Federal On-Scene Commander under the FRERP coordinates the FRERP response with the FCO, who is responsible for coordination of all Federal support to State and local governments. (Operational interfaces between the FRP and other Federal emergency plans are covered in more detail in the pertinent ESF and incident annexes.) For WMD and Terrorism incidents, the LFAs for Crisis and Consequence Management, respectively.

Lethal Chemical Agent. Chemical agents designed primarily to cause death to exposed personnel. Included are: Blood, Choking, and Nerve (See Chemical Agents).

Lethal Dose. The amount of a toxic substance that has a fatal effect on humans. This can be for military chemical agents or industrial agents.

Low level radiation. Exposure from radioactive sources that is higher than those routinely received by health physics workers and the general public and are in the range from background radiation to 70 cGy. The primary consequence of exposure may be induction of cancer in the longer term post exposure. The hazard from LLR may result from alpha, beta, or gamma radiation.

Mission-Oriented Protective Posture. A flexible system that provides the maximum NBC protection for the individual with the lowest risk possible and still maintains mission accomplishment.

MOPP Gear. Military term for individual protective equipment which includes: protective suit, boots, gloves, mask with hood, first aid treatments, and individual decontamination kits.

NBC Defense. Measures which enable personnel to provide and effective defense against the effects of chemical, biological, agents, radiological material, WMD, and TIM.

Non-persistent Agent. A chemical agent that dissipates and/or loses it ability to cause casualties within 10 to 15 minutes after release.

National Response Center. The NRC is the 24-hour NRT communications center located at Coast Guard Headquarters, Washington, DC. The NRC receives telephone reports of accident-incidents, WMD, TIM hazards and is capable of notifying or requesting assistance from all Federal agencies.

National Response Team. The NRT is composed of 14 Federal agencies charged with the responsibility for providing oversight of the nation's ability to respond to accident-incidents. The NRT is responsible for national level planning, preparedness, and response actions. the NRT does not respond directly to a CAI but is available to provide for additional resources if requested.

On-Scene. The total area that may be impacted by the effects of an extraordinary situation. The on-scene area is divided into mutually exclusive on-site and off-site areas. Area boundaries may be circular or irregular in shape and will be established, depending on the situation.

On-Scene Commander. The military officer or senior official who commands forces and supervises all operations at the scene of accidents or significant incidents. Directs actions at a accident-incident/disaster site to mitigate damage, save lives, restore primary mission asserts, and assist civil authorities, normally the installation support group commander.

On-Scene Coordinator. The federal official pre-designated to coordinate and direct federal response.

Operational Control (OPCON). Operational control is a command relationship which includes those functions of command involving the composition of subordinate forces, the assignment of tasks, the designation of objectives, the authoritative direction necessary to accomplish the mission. It does not include such matters as administration, discipline, internal organization, and unit training, except when a subordinate commander requests assistance.

Pathogen. A microorganism that is capable of producing disease in man, animals, and plants.

Percutaneous. Chemical agents that have the ability to cause damage to humans by passing through the skin. This is generally termed a route of entry into the body.

Persistency. A measure of the duration for which a chemical agent is effective. Persistency will vary agent by agent and cased by case since the environment, weather, and terrain play a crucial part of the duration of chemical agent's persistency.

Persistent Agent. A chemical agent that when released remains able to cause casualties for more than 24 hours to several days or weeks.

Precautionary Zone. The outermost portion of the emergency planning zone and extends to a distance where no adverse impact to human health would be experienced in the event of a maximum potential release under conservative most likely meteorological conditions. This area is referred to as the Cold Zone in other publications.

Protection. Measures that are taken to keep NBC, WMD, TIM hazards from having an adverse effect on personnel, equipment, or critical assets and facilities.

Protection Factor. The expected level of respiratory protection provided by a properly functioning, properly fitted mask to trained users. Represents a ratio of the agent concentration outside the protective mask to the concentration inside the mask that will be breathed by the wearer. This is also the expected level of radiation that is absorbed by a given material at a specific density or a given piece of equipment.

Protective Mask. A piece of the protective ensemble designed to keep the wearer from breathing air contaminated with chemical and/or biological agents.

Radioactivity. The spontaneous emission of radiation, generally alpha or beta particles, often accompanied by gamma rays from the nuclei of an unstable isotope. As a result of this emission the radioactive isotope decays into the isotope of a different (called a daughter) element which may also be radioactive. Ultimately, a stable (nonradioactive) end product is formed.

Radiological dispersal device. Any device that is intended to spread radioactive material. An improvised nuclear device can be an radiological dispersal device if the explosion does not cause a nuclear yield, but "fizzles," spreading radioactive materials.

Reconnaissance. A mission undertaken to obtain information by visual observation, or other detection methods, about the activities and resources of an enemy or potential enemy, or about the meteorological, hydrographic, or geographic characteristics of a particular area. Reconnaissance differs from surveillance primarily in duration of the mission.

Regional Response Team. Planning, policy, and coordinating bodies that develop regional contingency plans and coordinate participating agencies' activities supporting the on-scene coordinator. They do not respond to accident-incidents but rather provide advice or material or informational support to the OSC upon request. The RRTs have no authority other than a review and advisory role. There are 13 RRT supporting the 10 Federal regions in CONUS, plus one in Alaska, the Caribbean, and the Pacific Basin.

Response Task Force: There are two RTF headquarters, RTF-East, assigned to 1st U.S. Army (FORSCOM), and RTF-West, assigned to 5th U.S. Army (FORSCOM). They are distinct from their parent U.S. Army headquarters and exercise command and control of DOD assets (minus Special Operations Forces). The RTF is not a force provider, but rather receives OPCON of DOD forces and exercises command and control of these assets in support of the LFA as it responds to a WMD event. The combination of the headquarters and the OPCON assets form the RTF.

Significant Threat. The confirmed presence of an explosive device or Weapons of mass Destruction (WMD) capable of causing a significant destructive event, prior to actual injury or property loss.

Special Event: (DOD Directive 2000.15, Support to Special Events) A planned program of athletic competition and related activities involving participants from the United States and/or other nations. Historic examples of such events are the Olympic Games, the Pan American Games, the World University Games, and the International Special Olympics. The Secretary of Defense may also designate non-athletic international or national events to receive support in accordance with this Directive. Historic examples of such non-athletic special events include Summits, World's Fairs, and the Universal Postal Union Congress. Support may include equipment, personnel, technical or managerial advice, or guidance. Support may be funded on a reimbursable basis or by specific appropriation. Special Events are designated as National Special Security Events (NSSE) when so designated by the Attorney General and Secretary of Treasury.

Stay Time. The length of time a person may remain in contaminated or hazardous area, particularly in personal protective equipment (PPE).

Survey. Directed effort by individuals or teams to determine the location, area effected, and identification (if possible) of chemical agents and/or radiological material in a specific location.

Technical Escort - Individuals of the separate services that are technically qualified, equipped, and properly protected to accompany shipment(s) of designated materiel that require a high degree of safety and security.

Technical Operations. Those operations that serve to identify, assess, dismantle, transfer, dispose, decontaminate, leak-seal and package, render safe, and safely escort for disposal an explosive ordnance or Nuclear, Biological, and Chemical (NBC) material or related hazardous materials.

Techniques. Method or manner of using individual skills to accomplish a specific function in the accomplishment of a mission.

Terrorism. The calculated use of violence or threat of violence to inculcate fear; intended to coerce; or to intimidate governments or societies in the pursuit of goals that are generally political, religious or ideological.

Terrorist Incident. A violent act, or act dangerous to human life, in violation of the criminal laws of the U.S. or of any state, to intimidate or coerce a government, the civilian population, or any segment thereof, in furtherance of political or social objectives.

Toxic Industrial Chemicals. Any chemical hazard which is toxic and/or lethal and which is not designed specifically for military purposes, however, may be employed as a chemical warfare agent.

Warm Zone. Area between the Hot and Cold zones where personnel and equipment decontamination and hot zone support take place. It includes control points for the access corridor and thus assists in reducing the spread of contamination. Also referred to as the contamination reduction corridor (CRC), contamination reduction zone (CRZ), yellow zone or limited access zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

Weapons of Mass Destruction. In arms control usage, weapons that are capable of a high order of destruction and/or of being used in such a manner as to destroy large numbers of people. Can be nuclear, chemical, biological, and radiological weapons, but excludes the means of transporting or propelling the weapon where such means is a separable and divisible part of the weapon. Also called **WMD. (**JP 1-02**).** Title 18, USC. 2332a, defines a weapon of mass destruction as (1) any destructive device as defined in section 921 of this title, [which reads] any explosive, incendiary, or poison gas, bomb, grenade, rocket having propellant charge of more than four ounces, missile having an explosive or incendiary charge of more than one-quarter ounce, mine or device similar to the above; (2) poison gas; (3) any weapon involving a disease organism; or (4) any weapon that is designed to release radiation or radioactivity at a level dangerous to human life."

Appendix G
ACRONYMS

AAR	After Action Report
AC	Air Conditioning
ACADA	Automatic Chemical Agent Detector and Alarm
AFI	Air Force Instruction
AFM	Air Force Manual
AIT	Aeromedical Isolation Team
AO	Area of Operation
AOR	Area of Responsibility
APR	Air Purifying Respirator
ARE	Augmentation Response Element
ARNG	U.S. Army National Guard
ASD SO/LIC	Assistant Secretary Of Defense for Special Operations & Low Intensity Conflict
AT	Antiterrorism
BDO	Battle Dress Overgarment
BIDS	Biological Integrated Detection System, M31 or M31A1
^{o}C	degrees Centigrade
C^2	Command and Control
CAAP	Critical Asset Assurance Program
CAI	Chemical Accident-Incident
CAIRA	Chemical Accident Response and Assistance
CAM	Chemical Agent Monitor
CAT	Crisis Action Team
CB	Chemical-Biological
CBD	Chemical-Biological Defense
CBIRF	Chemical Biological Incident Response Force
CB-RRT	Chemical Biological Rapid Response Team
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cGyph	Centigray per hour
CALL	Center for Army Lessons Learned
CINC	Commander in Chief
CJCS	Chairman, Joint Chiefs of Staff
CJCSI	Chairman Joint Chiefs of Staff Instruction
CJTF-CS	Commander, Joint Task Force-Civil Support
CMA	Chemical Manufacturers Association
CMRT	Consequence Management Response Team
COCOM	Combatant Command
COMSEC	Communications Security
CONEX	Container Express
CONOPS	Concept of Operations
CONPLAN	Concept Plan

CONUS	Continental United States
CONUSA	Continental United States Army
COTS	Commercial Off The Shelf
CP	Command Post
CPE	Collective Protection Equipment.
CRZ	Contamination Reduction Zone
CSD	Chemical Support Division
CSM	Chemical Surety Material
CWA	Clean Water Act
DA	Department of the Army
DART	Disaster Assistance Response Team
DCE	Defense Coordinating Element
DCO	Defense Coordinating Officer
DERP	Defense Environmental Restoration Program
DFO	Disaster Field Office
DHHS	Department of Health and Human Services
DIRLAUTH	Direct Liaison Authorized
DOD	Department of Defense
DODD	Department of Defense Directive
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DOMS	Director of Military Support
DON	Department of the Navy
DOS	Department of State
DOTMLP	Doctrine, Organization, Training, Materiel, Leader Development, Personnel
DP	Disaster Preparedness
DRF	Disaster Response Force
DSO	Domestic Support Operations
DS-2	Decontamination Solution 2
DTRA	Defense Threat Reduction Agency
ECBC	Edgewood Chemical Biological Command
ECP	Entry Control Point
EMS	Emergency Medical Services
EOC	Emergency Operations Center
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
EPDS	Emergency Personnel Decontamination Station
EPLO	Emergency Preparedness Liaison Officer
EPZ	Emergency Planning Zone
ERT	Emergency Response Team
ESF	Emergency Support Function
EZ	Exclusion Zone
^{o}F	degrees Fahrenheit
FBI	Federal Bureau of Investigation
FCO	Federal Coordinating Officer
FEMA	Federal Emergency Management Agency

FEST	Foreign Emergency Support Team
FHA	Foreign Humanitarian Assistance
FORSCOM	(U.S. Army) Forces Command
FM	Field Manual
FP	Force Protection
FPD	Flame Photometric Device
FRERP	Federal Radiological Emergency Response Plan
FRP	Federal Response Plan
FUNCPLAN	Functional Plan
GC	Gas Chromatograph
GPS	Global Positioning System
GSA	General Services Administration
HAZMAT	Hazardous Material
HN	Host Nation
HNS	Host Nation Support
IAW	In accordance with
IC	Incident Command
ICS	Incident Command System
IM	Information Management
IPE	Individual Protective Equipment
IPLAN	Implementation Plan
IR	Information Requirements
IRE	Initial Response Element
IRT	Incident Response Team
IRZ	Immediate Response Zone
ISA	Interservice Support Agreement
JCS	Joint Chiefs of Staff
JFC	Joint Force Commander
JIC	Joint Information Center
JIISE	Joint Interagency Intelligence Support Element
JOC	Joint Operations Center
JOPES	Joint Operations Planning and Execution System
JS	Joint Staff
JSCP	Joint Strategic Capabilities Plan
JSOTF	Joint Special Operations Task Force
JTAC	Joint Technical Augmentation Cell
JTF	Joint Task Force
JTF-CS	Joint Task Force-Civil Support
JTP	Joint Training Plan
JULLS	Joint Universal Lessons Learned System
LFA	Lead Federal Agency
LLR	Low Level Radiation
LOC	Lines of Communication
MACA	Military Assistance to Civil Authorities
MACDIS	Military Support to Civil Disturbances
MACOM	Major Commands
MAJCOM	Major Command

MCHT	Modular Chemically Hardened Tent
MCPS	Modular Command Post System
MEAP	Mobile Environmental Analytical Platform
MEDCOM	Medical Command
METT-TC	Mission, Enemy, Time available, Terrain and weather, Troops and support available, Civilians
MGPTS	Modular General Purpose Tent System
MILVAN	Military-Owned Demountable Container
MOOTW	Military Operations Other Than War
MOPP	Mission-Oriented Protective Posture
MOU/MOA	Memorandum of Understanding/Memorandum of Agreement
MRCP	Manpower Requirements Change Package
MSCA	Military Support to Civil Authorities
MSD	Military Support Detachment
MSLEA	Military Support to Law Enforcement Agencies
NAERG	North American Emergency Response Guide
NBC	Nuclear, Biological, and Chemical
NBC-R	Nuclear, Biological, Chemical, Radiological
NBC-PC	Nuclear, Biological, Chemical – Protective Cover
NCA	National Command Authority
NCP	National Contingency Plan
NDA	National Defense Area
NDMS	National Disaster Medical System
NDPO	National Defense Preparedness Office
NEST	Nuclear Emergency Support Team
NFPA	National Fire Protection Association
NGB	National Guard Bureau
NGO	Non-Governmental Organization(s)
NIOSH	National Institute for Occupational Safety and Health
NMCC	National Military Command Center
NOAA	National Oceanic and Atmospheric Administration
NRC	National Response Center
NRS	National Response System
NRT	National Response Team
OCONUS	Outside the continental United States (includes Alaska and Hawaii)
OEG	Operational Exposure Guide
OFDA	Office of Foreign Disaster Assistance
OPCON	Operational Control
OPLAN	Operations Plan
OPORD	Operations Order
OPSEC	Operations Security
OSC	On-Scene Commander
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
PA	Public Affairs
PAO	Public Affairs Officer
PAZ	Protective Action Zone

PZ	Precautionary Zone
PDD	Presidential Decision Directive
PHS	Public Health Service
POC	Point of Contact
POM	Program Objective Memorandum
PPBS	Planning, Programming, & Budgeting System
PPE	Personal Protective Equipment
PVO	Private Volunteer Organization
RAT	Radiation Assessment Team
RADIAC	Radiation Detection, Indication, and Computation
RFA	Request for Assistance
ROE	Rules of Engagement
RRT	Regional Response Team
RTAP	Real Time Analytical Platform
RTF	Response Task Force
SAC	Special Agent in Charge
SARA	Superfund Amendment and Reauthorization Act
SBCCOM	Soldier Biological Chemical Command
SCBA	Self Contained Breathing Apparatus
SCO	State Coordinating Officer
SECARMY	Secretary of the Army
SECDEF	Secretary of Defense
SEP	Special Events Package
SJA	Staff Judge Advocate
SMART	Special Medical Augmentation Response Team
SMART-CB	Chemical/Biological Special Medical Augmentation Response Team
SMART-PM	Preventive Medicine threat Assessment Special Medical Augmentation Response Team
SMART-V	Food Safety, Veterinary Preventive Medicine, and Animal Health Care Special Medical Augmentation Response Team
SOF	Special Operating Forces
SOFA	Status of Forces Agreement
SRE	Site Response Element
STB	Super Tropical Bleach
SZ	Support Zone
TAG	The Adjutant General
TEMPER	Tent Extendible Modular, Personnel
TEU	Technical Escort Unit
TFA	Toxic Free Area
THREATCON	Threat Condition
TIC	Toxic Industrial Chemicals
TIM	Toxic Industrial Materials
TTP	Tactics, Techniques, and Procedures
UC	Unified Command
US	United States
USACE	U.S. Army Corps of Engineers

USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
USAF	U.S. Air Force
USAFR	U.S. Air Force Reserve
USAID	U.S. Agency for International Development
USAMEDCOM	U.S. Army Medical Command
USAMRICD	U.S. Army Medical Research Institute of Chemical Defense
USAMRIID	U.S. Army Medical Research Institute for Infectious Diseases
USAR	U.S. Army Reserve
USC	U.S. Code
USCG	U.S. Coast Guard
USG	U.S. Government
USJFCOM	U.S. Joint Forces Command
USMC	U.S. Marine Corps
USMC	U.S. Marine Corps
USMCR	U.S. Marine Corps Reserve
USN	U.S. Navy
USPACOM	U.S. Pacific Command
USSOUTHCOM	U.S. Southern Command
USSS	U.S. Secret Service
UTM	Universe Transverse Mercator (Grid Referencing System)
WMD	Weapons of Mass Destruction
WMD-CST	Weapons of Mass Destruction Civil Support Team
WMDRF	Weapons of Mass Destruction Response Function
WWMCCS	World Wide Military Command and Control System

1

APPENDIX H

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